MODEL ENGINEER

Vol. 194 No. 4247

13 - 26 May 2005

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Ideally matched to the BV-20 Lathe

Table size	654mm x 150mm
Longitudinal travel	455mm
Cross Travel	145mm
Spindle Stroke	90mm
Spindle Taper	3MT
Diameter of Spindle	63.5mm
Diameter of Column	66.65mm
Throat	165mm
Max distance spindle to table	320mm
Height with head at top of column	1067mm
Width	775mm
Depth	559mm
Spindle speeds	400-1640
Motor	1 phase 1/2hp with F/R switch
Weight	295lb
Head tilting	90-0-90 worm gear tilt mechanism

Warco, Fisher Lane, Chiddingfold, Surrey GU8 4TD Fax: 01428 685812
Tel: 01428 682929 warco@warco.co.uk www.warco.co.uk

Model Engineer is published by
HIGHBURY LEISURE Publishing Limited
Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0PS
Tel: 01689-887200 Fax: 01689-886666
www.hhc.co.uk/modeng
HIGHBURY LEISURE Publishing Limited, a
HIGHBURY HOUSE COMMUNICATIONS PLC
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Origination by
Atelier Data Services

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Direct Subscriptions and Back Issues are available from
Model Engineer, Tower House,
Sovereign Park, Market Harborough, Leics. LE16 9EF
Order hotline: 0870 8378600; Customer Service: 0870 8378668
Email: modelengineer@subscription.co.uk
(Operating hours: 8am-9.30pm Mon-Fri; 8am-4pm Sat.)
Rates for 26 issues (annual):
UK: £65.00 Europe: £80.00 US Airmail: $130.00
RoW Airmail: £86.00
Cheques payable to Highbury Leisure Publishing Ltd.
Second class postage paid at Rahway NJ USA.
Postmaster, please send address corrections to
Model Engineer c/o Mercury Airfreight International Inc,
2323 Randolph Avenue, Avenue 1, NJ 07001. Usps 0011099.
US Subscription Agent: Wise Owl Worldwide Publications,
5150 Candlewood Street, Suite #1
Lakewood, CA 90712-1900, USA
Phone: 562-461-7574; Fax: 562-461-7212.
Email: info@wiseowlmagazines.com
Website: www.wiseowlmagazines.com
Visa/MC/Discover accepted.
Canadian Distribution by Gordon & Gotch Periodicals
(Toll free 1-800-438-5005).
Model Engineer is published fortnightly.

ISSN 0026-7325

IN THIS ISSUE

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On the cover …

A geometric chuck/tympan chuck combination in use on an ornamental lathe featured on the Society of Ornamental Turners stand at the Model Engineer Exhibition 2004. This was one of several fascinating pieces of tooling to be seen on this stand and many visitors were enthralled by the demonstrations that were held continuously during the course of the event. For further details of the many club stands at the 74th Model Engineer Exhibition turn to page 552 of this issue.

(Photograph by Neil Read)

TURN TO PAGE 540 FOR GREAT OFFERS ON SUBSCRIPTIONS

INDEX to ADVERTISERS

gandmtools

Have a look at our new website, new arrivals page changing every day

web: www.gandmtools.co.uk **email: sales@gandmtools.co.uk**

LATHES
Engineers Tool Room BL9/20 centre Lathe with Stand & Tooling, 240 Volt,VGC .... £ 550.00
Emco Maximat Super 11 Centre Lathe,Tooling, 3ph,VGC £2100.00
Emco Maximat Super 11 Centre Lathe,Tooling, 3ph,VGC £2100.00
Emco Maximat Super 11 Centre Lathe,Tooling, 3ph,VGC £2100.00
Emco Maximat Super 11 Centre Lathe,Tooling, 3ph,VGC £2100.00
Conect Cadet Plus CNC Lathe, Used Once Only,240 volt, ... £1450.00
Pultra 1750 Bench Lathe, Drive Unit, Collets, Chucks,Tooling,1ph,VGC.......... £1500.00
Pultra 1750 Bench Lathe, Motor,Well Tooled,Collets,1ph,VGC.......... £1500.00
Pultra 1770 Bench Lathe c/w Handrest,Tailstock, 10 Collets,No Motor .... £ 350.00
Denford Starturn CNC Bench Lathe,1ph, Manual £1000.00
Denford Orac CNC Bench Lathe,1ph, Manual £1450.00
Boxford AUD 5" x 22" Lathe, Well Tooled, New 240 Volt Single Phase Motor,VGC £1850.00
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Boxford AUD 4½" x 18" Lathe,Tooled,New Single Phase Motor Fitted £1250.00
Boxford Model A 4½" x 18" Lathe,Stand,Gearbox,PCF,Tooling,Single Phase £1250.00
Myford Super 7B Longbed,3½" x 30",Green,3 & 4 Jaw,Faceplate,QCTP,Steady,1ph.......... £2000.00
Myford ML7 3½" x 19" Lathe .... £ 650.00
Myford Super 7 Long Bed Bench Lathe, 1ph, Old, ..£ 600.00
Myford Super 7 Bench Lathe with Tray & Blocks, 1ph, Tooling, ... £1000.00
Colchester Triumph 2000 Gap Bed Lathe, 7½" x 50", 3ph,Tooled.......... £2500.00
Colchester Triumph RH Gap Bed Lathe, Well Tooled, 3ph £1250.00
Colchester Chipmaster 5" x 20" Lathe,Metric,Tooled,Quiet,VGC,3ph £1500.00
Colchester Bantam 1600 5" x 20", (Late Type) Chucks,Lever Op Collet Att,Coolant, QCTP,Guards,Light, Manual, 3ph, VGC.......... £2500.00
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Harrison L5 4½" x 25" Gap Bed Lathe,Well Tooled, Variable Speed Drive,1ph,GC £1200.00
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Acorn Capstan Lathe, 1ph, Cut Off Slide, Old.......... £ 325.00

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BCA Jig Borer/Mill, Stand, Collets,3ph, ... £ 975.00
BCA Jig Borer/Mill, Stand, 4 Collets,Keyless Chuck, Vice,1ph.......... £ 975.00

Boxford VM30 Variable Speed Vertical Mill,30 INT Spindle,Collet Chuck,3ph .... £ 800.00
Tom Senior Vertical Milling Head,2MT .... £ 500.00
SIP Mill/Drill,NEW,1ph,3MT.......... £ 799.00
Stand For Above .... £ 145.00
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Strausak Gear Hob Sharpener .... £ 350.00
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Hauser 2 BA Jig Borer,3ph £1500.00
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Avon CNC Vertical Mill,Anilam Crusader 2 Control, 3ph, Not Working, ... £ 500.00

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Axminster Power Tools Metal Cutting Bandsaw,1ph.......... £ 150.00
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Startrite 18-S-5 Vertical Bandsaw,1ph, 240 Volt ......£ 750.00
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100/127T Compound Gear £55,
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Boxford Cross Slide Stop.......... £ 25.00
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Colchester Student 1800 6" x 40" Gap Bed Lathe, 3 & 4 Jaw Chucks, QCTP, Faceplate, Catchplate, Drill Chuck, Manual, 3phase, Very Good Condition, **£5250.00 plus vat.**

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Boxford T-Slotted Cross Slide, Fits all the Belt Drive Models, New, **£125.00 plus vat**

Startrite 18-S-5 Vertical Bandsaw, 3 phase, **£650.00 plus vat.**

Benson Verniers Gear Tooth Vernier, 2.5mm - 25mm Capacity, Case, **£100.00 plus vat.**

Bantam 2000 6 Station Capstan Attachment, Good Condition, **£350.00 plus vat.**

All items are subject to availability. All items are subject to postage and packing and vat @ 17.5%.

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SMOKE RINGS
With the Editors

Not to be missed
Kinver Open Weekend on June 18 and 19, and the Kinver Diesel weekend on July 2 and 3. Contact Mike Harrison on 0121 602 2019.
Sweet Pea Rally, Nottingham, on June 11 and 12. Nick Harrison on 0115 953 1911.

NG IMLEC
Applications are being invited for the Narrow Gauge IMLEC, organised by the Northern Association of Model Engineers. The hosts this year are the Wrexham Society of Model Engineers, and the event takes place over the weekend of 5/6 June.

Places are limited, so apply as soon as possible to take part in this popular annual event. Contact: J. Holdsworth, Southway, Pant Lane, Gresford, Wrexham LL12 8HB.

Strawberry season
The Strawberry Line Miniature Railway has just added a new engine shed, based on the old Bath Road, Bristol diesel depot. This railway is commercially operated, running on 5in. ground level track. The double tracked line is said to be the largest commercial railway of this type in the UK.

The original depot stood at the west end of Temple Meads station, and was demolished to make way for an entertainments centre. The small version now houses the Strawberry Line's fleet of locomotives.

A fleet of battery powered, diesel outline, locomotives are the mainstay of the operation, with more locomotivess and rolling stock being added. A steam powered A2 pacific, *Blue Peter*, has been steam tested, and is ready to enter service. Locomotives and rolling stock are built at the Railway's own workshops.

The railway features a station, tunnel, sheds and turntable. A signal box is now being fitted out. The railway also has a collection of model freight wagons.

It is open from Easter until the end of October on Tuesdays and Sundays, and some other days during school holidays and the peak summer holiday period. You can find it in the Avon Valley Country Park, near Keynsham, Bristol, between the Great Western main line, and the River Avon. Access is via Pixash Lane, off the A4 between Keynsham and Saltford.

To find out more contact the owner, Mike Bass, on 079601 51286.

New cats
Model railway builders and operators will be familiar with the products of the Miniature Railway Supply Co. Limited. Rail, sleepers, signals, points, signs, and everything else to make the trains run can now be found in their first catalogue, which replaces the old style information sheets.

A website has also been set up, complete with downloadable version of the new catalogue. Contact details: **The Miniature Railway Supply Co Ltd, 42 Stratford Way, Boxmoor, Hemel Hempstead, Herts HP3 9AS tel: 01442 214702; website: www.miniaturerailwaysupply.com**

Folkestone Engineering Supplies also has a new catalogue out, with its comprehensive range of aluminium alloys, brass, copper, phosphor bronze, nickel silver, bright and black mild steels, spring steel, silver steel, ground flat stock, and cast iron. Also a wide range of fasteners, taps and dies. Contact them on **01303 894611, or visit www.metal2models.btinternet.co.uk**

A new online shop has been set up by **Walsh**, with plenty to interest clock makers and model engineers. Almost 12,000 items are available to order online, ranging from abrasives to zirconia.

What is more there are hints and tips, and details of training.

You can still contact or visit the firm's showrooms in Beckenham, London and Birmingham, to buy products and obtain technical assistance. **www.hswalsh.com**

TINOLOGY
A discourse on tin has found its way onto the editor's table. As every non-engineer knows all metal is 'tin'. Here are some definitions to help the layman:

Brass: Useful tin mined in Yorkshire, and is said to occur where there is muck. Used to make monkeys, bed knobs, and lots of money.
Nickel: Tin used to make American money.
Lead: Heavy tin used to make the centre of pencils, and poisonous paint for children's toys. Also very useful for stopping church roofs from blowing away.
Steel: What people do to the lead tin on church roofs.
Aluminium: Very light tin, used to make tins.
Wire: Thin tin made by drawing through boilers.
Tinny: Australian tin in bars.
Mercury: Runny tin. Gets longer as it gets hot, so ideal for thermometers.
Iron: Flat tin for taking small creases out of shirts, and putting large ones in. The right sort of iron can be used to glue bits of tin together – after they have been tinned.
Rust: Crumbly tin made by the tin worm, extensively used in making cars.
Chrome: Shiny tin used to hold rust together.
Zinc: Used for washing potz and panz.
Titanium: Super strong tin used in foundation garments.
Tin plate: The alternative to china for all except traction engine drivers.
Tin glass. Guinness container.
Copper: Very, very, very expensive tin for kettles used by policemen.
Tungsten, Sodium, and **Strontium**: Light tins. Tungsten grows from bulbs, and sodium grows on long stalks by the side of the road. Strontium glows feebly in the dark, and in your watch lets you know what time the lights went out.
Barium: Edible tin fed to hospital patients suffering from transparency.
Gold: Tin that is too soft to be of much use.
Silver: Also soft and useless.
Magnet: Attractive tin.
Uranium: Hot tin containing little gadgets known as atoms. Useful for model submarines.
Platinum and **Osmium:** Tins used to make pens used with **Indium** ink.
Tinsel: Tin only found in Hollywood.

CHUCK, the MUDDLE ENGINEER — **by B. TERRY ASPIN**

POST BAG

A furtive approach!

SIRS, - With regard to Dick Clifton's letter (*M.E.* 4237, 24 December 2004), I would recommend that one eschew a furtive approach when requiring something from the drapery department. A smiling approach to the lady behind the counter, coupled with the fact that an old bloke makes a change, (though a young one might make a better change!), will ensure instant help. Some years ago, I complained to the lady in the Katoomba Stitchery that the black elastic on a card lasted less time in use on my welding goggles than it took to thread the wretched stuff. What you need, she said, is Bra Elastic. She only had pink in stock, which clashed with the holly green of the goggles, but I couldn't see it when the goggles were in use. A metre will do two pairs.

Having moved across the continent, and about to go on a shopping expedition with our youngest, I asked if she knew where I could get some bra elastic. She didn't, but looked up the *Yellow Pages* and enquired of a conveniently located shop. On being asked for specifications, she said she didn't know, but would hand the phone over to father. I told the lady at the other end that I hadn't gone peculiar in my old age, and why I wanted it. She giggled, and when we entered the shop an hour later, came out from behind the counter, and asked if we wanted bra elastic, and what quantity. No bother, and smiles all round. Of course one could send the Missus or girlfriend, but it would be less fun. (And they might get the wrong width!)

Derek Cooke, W. Australia.

Hot Air Engine confusion

SIRS, I found Mike Thurgood's article on *How Hot Air Engines Work* (*M.E.* 4243, 18 March 2005) very puzzling. Three illustrations to show how a piston would move according to pressure, and not a single illustration of the Stirling Cycle! Surely any reader who was not familiar with the Stirling Cycle would be totally confused after reading this?

As for the final paragraph, does Mr. Thurgood really believe that a submarine's batteries would be used to electrically heat a hot air engine to drive the submarine! Why not use heat to boil water and drive the sub by steam power.

The Swedish submarines referred to will be those built by Kockums using what is called an 'Air Independent Propulsion' system. A highly pressurised Stirling Engine uses Helium rather than air to be heated and cooled to drive the engine. This is because Helium only requires about 1/6 of the heat that air requires in order to do the same amount of work.

Electricity from the batteries is *not* used to heat the engine, the Stirling engine does *not* drive the submarine (at least not directly) but drives a generator that charges the batteries. This allows the Stirling engine to always operate at the most efficient speed, not having to be throttled in any way for slow travel.

The fuels used to run the Stirling engine are diesel fuel and oxygen. The two are burned together in a combustion chamber at such a high pressure that after cooling the exhaust products can be discharged into the sea at any depth, without the use of a compressor.

Readers (and Mr. Thurgood) may like to take a look at **http://www.kockums.com/Submarines/aipstirling.html** for further information.

Dick Gays, Leicester.

Not actually the case

SIRS, - As an avid reader of your magazine, and a novice model engineer at that, I eagerly read the articles on how to make things. It is also nice to have the odd technical article, and as technical is what I do (did) I feel I have to comment when something does not appear quite right. Mike Thurgood's article on hot air engines (*M.E.* 4243, 18 March 2005) is a good general article on how these engines work. However, he rather implies that cooling is necessary to make them work. This is not actually the case.

The Stirling cycle is a brilliant piece of thermodynamics, and is perhaps unique among heat engines in that it is thermodynamically reversible. That is if you put heat in the hot end you can extract it as work at the cold end. Alternatively if you put work in the cold end, i.e. drive the power piston, you can extract heat at the hot end. In this case if you provide cooling at the cold end you can obtain refrigeration at the hot end.

For the hot air engine case, what is not generally appreciated is that when you expand a gas and make it do work it gets cold. The work achieved by the power piston corresponds to the pressure drop between TDC and BDC of the power piston. However, as there is no such thing as a free lunch only about 80% of this energy appears as work. The remainder is used to expand the gas, and as this energy comes from the gas itself it gets cold. Gas expansion is widely used commercially to produce very low temperatures and liquid air is made this way, although high pressure drops are required. The important point in the engine is that the temperature is reduced somewhat below ambient. This, together with the increase in volume resulting from the addition of the power cylinder volume, results in a pressure less than atmospheric and hence the atmosphere can push the piston back to TDC.

If the low pressure was dependent on cooling the engine probably would not work. As the starting condition is atmospheric air, cooling with ambient air or water would only achieve a cooled temperature of not less than about 10deg. F above ambient, which would not be enough to produce a pressure less than atmospheric. Why cooling is provided is that when you heat one end of the displacer cylinder, the other end sooner or later gets hot due to conduction. It is necessary to remove this heat to allow the cold end to become sufficiently cool and not negate the cooling due to expansion. If you study Roy Darlington's engines you will note many of them use test tube like glass tubes for the displacer cylinder. Glass has poor conduction, so that while one end is hot it is possible to touch the cold end (very gingerly!).

The advantage of pressurising the engine is that it allows the system to contain more air. At ambient conditions the density of air is 0.081 lb/ft.^{3} and it has a specific heat of only 0.25 BTU/lb/deg. F. Thus a model engine can only contain a minute mass of air which can only hold a minute amount of heat. Hence the power output is minute. Pressurising the engine to 10 atm. (say) allows it to contain 10 times the amount of air which would increase the power by a factor of 10. In order for the engine to work it would be necessary to surround it with an 'atmosphere' also at 10 atm. in order to get the equivalent affect of the atmosphere pushing against a partial vacuum (the pressure inside might drop to say 9.5 atm. after expansion). I believe the Philips engine had a pressurised crankcase to achieve this affect. The pressure itself has no direct effect on the power.

While I seem to have waffled on a bit, at least if anyone asks you how a hot air engine works, between Mike Thurgood and myself you should know the answer. I am also flattered that you quote from my articles in Sutton MEC's *Newslink*, under *Club Chat*. I now know that at least one person reads them!

Keith Roper, Surrey.

All fired up

SIRS, I was quite disheartened to read Mr. Trendall's warning (*M.E.* 4240, 4th February 2005) that making a copy of the Gatling Gun advertised in your pages could, nay would put me the wrong side of the law. I was even more disheartened when I read the statement in from the Forensic Science Service (*M.E.* 4243, 18 March 2005). Had it not been for the developments in the arms industry we could still be waiting for a viable steam engine. What better example of 19th century engineering wizardry was there that was neither steam nor clockwork driven than a model of a Gatling Gun, non-functional of course. Not so long back there was a similar warning in your pages on the scope of current fire arms legislation with regard to model brass cannon. This advised getting a shotgun license if the touch hole and bore were to meet. Perhaps this advice also extends to any cross drilled piece of metal.

I have to admit a fascination for both the Colt 1851 Navy Revolver and the Gatling Gun and wonder if there is any advice on making examples of these machines and also staying well within the law. This statement, in the current climate, will no doubt offend many people but I make no apology. These inventions represented the pinnacle of mid 19th century engineering development and mass production, far out classing the humble steam locomotive of the time. I want to experience the challenge of building a replica to the best of my limited abilities. I see this as an art form and certainly less offensive than some examples of recent published 'art'.

After reading such a robust warning on the perils of firearms modelling I was very surprised to read in the same issue the start of a series featuring the construction of a 5.5in. field gun. Surely this cannot be so. What if this weapon was modified to take live ammunition? Yes, I know ridiculous.

Is there now good reason for enticing either Mr. Trendall or

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Correspondence for *Post Bag should* be sent to: -
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or to dcarpenter@highburyleisure.co.uk
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someone from the Forensic Science Service (Firearms Section) into writing a definitive article for *M.E.* on what we can or cannot model and more precisely what details to include/exclude to ensure full compliance with UK law.
S. C. Walkley, Gloucs.

Political correctness?

SIRS, - I was disappointed to read in your latest *Smoke Rings* editorial (*M.E.* 4243, 18 March 2005) that you were intending to stop future adverts for the model Gatling gun, after all this is *Model Engineer*.

This appears to me to be yet another instance of the creeping political correctness which, if we are not careful, will destroy all forms of private initiative, where will they decide to strike next?

I personally have no interest in buying a set of these plans but I do admire the work that has been done in researching and preparing the drawings for publication.

As you know my interests lie in models of aero engines and it has been said that without the research necessary for production of these models a great deal of history would be lost forever.

Exactly the same thing can be said of the Gatling and I feel that denial of access to the result of this research is just another form of censorship.

The letter from Mr. Bottomley regarding the 1968 Firearms Act just makes me feel that it would be less of a waste of his time and our money if he concentrated on the ever increasing number of *real* guns in circulation amongst the criminal fraternity.

The only result of the above Act as far as I can see is that a great number of valuable collections were broken up and perfectly law abiding citizens were denied access to their chosen hobby. It has done nothing to attack the real problem and, as with most other legislation of this type, it is only the law abiding who have suffered any inconvenience.
Brian Perkins, Bristol.

Wake up Britain

SIRS, - With reference to the recent correspondence on the Gatling Gun (*M.E.* 4240, 4 February 2005). Whilst I endorse all comments relating to the danger and illegality of a complete weapon, I find it disturbing that the details and construction of such an item are considered to be 'unsuitable' to be even advertised, let alone published in the magazine. Anyone intent on producing a weapon of this nature, for ulterior motives, will do so irrespective of 'nanny state' attitudes. May I remind all concerned that model engineering is and always has been of an inquisitive and experimental nature, and long may it be so. We have seen the beginnings of official interference in our hobby, but, how long before some PC little busybody decides that we should destroy all information that is 'dangerous' (remember that books were burnt in the past under another dictatorship), and that all private workshops constitute some form of Health and Safety risk, or are indeed a danger to society? Wake up Britain.
Barry Hares, by e-mail.

Bearings

SIRS, - I refer to Douglas Reid's article on *Hobbymat Milling Head Repair* (*M.E.* 4243, 18 March 2005). If the bearings were lubricated for life then they are obviously time expired by 12 years of use. If they were indeed lubricated for life bronze bearings they may well have been sintered bronze bearings, although Douglas Reid does not enlighten us. Such bearings are oil filled during manufacture and generally last many years. The replacement with solid bronze albeit with a grease filled annulus is one solution however, even molybdenum disulphide loaded grease is in due course going to need some replacement despite its ability to 'run dry' for some time. External means of top up would appear to be desirable as Douglas Reid observes in his closing notes.
Ken Willson, Hants.

Irish model engineers?

SIRS, - I will be moving to West Cork in Ireland in the very near future. I was therefore wondering whether there are any model engineers in this part of Ireland who would like to make themselves known to me. I can be contacted most easily at my e-mail address of **deverett2003@yahoo.co.uk**

There must be some out there, somewhere!
David Everett, by e-mail.

Sock knitting - the very last word!

SIRS, - Mr. Derry Dickson's mystery object shown in *M.E.* 4241, 18 February 2005 is a Golden Fleece sock knitting machine, sold by the South British Manufacturing Co. Ltd., of 91-97 Clerkenwell Rd, London EC1. At least that is the address given for their 'Tuition Parlour' and sales office.

Sadly Mr. Dickson's machine appears to be in poor condition and is without the 80 latch needles needed to function. The vertical needles around the periphery perform the basic knitting, while the optional radial needles impart a ribbed effect to the sock. Sock knitting machines were made by a variety of manufacturers notably Griswold and were sold well into the 20th century. They were reportedly given to amputees from the Great War as they required only one hand to work them and created the means to earn a living.

They were not easy to operate but in the hands of an expert were capable of producing healed socks, hats, tea cosies, knitted place mats, mits and similar knitwear. I have a set of instructions for mine obtained through the kindness of the curator of Bradford Industrial Museum which has several working machines. I also acquired a peculiar accessory called a 'set up' with a retractable set of conically disposed hooks to aid threading up and starting, but I have not yet succeeded in making a complete sock. Several years ago I took it to Leeds University Textile Department where a technician showed me how to operate it, but every time it is operated one risks damaging the precious latch needles which are difficult to obtain now. However, you could try **www.angoravalley.com/sockmachines/accessories.html#Needles**

My machine came from a lady in Nottingham who used Griswolds placed with out workers to make expensive cashmere 'shooting' socks. The machines worked well with heavy gauge cashmere yarn.
Philip Purkis, West Yorkshire.

In the
NEXT ISSUE
of
MODEL ENGINEER

- **A new column on I/C engines starts**
- **Steam powered model aeroplane**
- **Gear cutting with hobs**
- **Outstanding fire engine models**
- **Fine classic regulator clock**
- **The Stuart Lathe**
- **Regular features including:**
  - ***Penrhos Grange***
  - ***Savage Wagon***
  - ***Volkswagen Engine***
- **The final article written by the late Martin Evans**

There was always a good crowd around the Ickenham DSME stand.

A visitor tries his hand at clock wheel cutting on the SMEE stand.

Tim Coles takes emeritus editor Mike Chrisp for a ride behind his gas turbine locomotive.

THE CLUB STANDS
AT THE 74th MODEL ENGINEER EXHIBITION

Malcolm Stride
reports on some particularly good support from the clubs that attended the Exhibition.

This year I have decided to group this report by 'floor' so we will start with the ground floor and work upwards. The first stand I visited was that of Ickenham DSME. As is usual with this club, although they are tucked away at the end of the ground floor there is always something interesting on the well laid out stand. This year, apart from the enormous *Tallisyn* locomotive on its building stand, the thing that caught my eye was the rope-making machine being demonstrated at the end of the stand. I am sure many model boat enthusiasts found this interesting. This one was built by Peter Cathcart to demonstrate the art of rope making to a scout group. Perhaps this will encourage some of them into model engineering.

Brian Thompson, Chairman of the Southern Federation of Model Engineering Societies, had a 'pitch' in the middle of the ground floor and this year the sixth edition of the very useful federation directory and supplement was available on the stand. These can also be obtained by mail order from Brian at 35 Rivershill, Watton at Stone, Herts, SG14 3SD. Mail order prices are £3.50 for the directory and £4.00 for the supplement, both inclusive of postage and packing.

At the other end of the ground floor was the Society of Model & Experimental Engineers. What can one say about the SMEE stand? It is always a hive of activity, this year being no exception with the stewards fielding all sorts of questions and hopefully solving the visitor's problems. Several models were being demonstrated in steam at the end of the stand to give visitors an insight into working steam models and as has been the pattern in the past several machining demonstrations were also taking place – when the stewards could escape the questions!

Ground Floor Annex

This year the annex which, in the past, has been the preserve of the Gas Turbine Builders Association and the I/C Engine Builders Group also included the National $2^{1}/_{2}$" Gauge Association and the Ruislip Lido Railway stand.

The I/C Engine Builders Group had a wide variety of different engines on their stand with a new one under construction being the Napier 'Dagger VIII' H24 engine by Norman Lawrence. This had very clear notices stating that *"all components have been manually machined"* and the finish on all the parts (including the two crankshafts) was certainly excellent. I shall look forward to seeing this running at some time in the future. A very different group of engines on the stand were the vintage and older style two stroke engines which many visitors could no doubt identify with because of their similarity to more modern engines. This part of the display also illustrated the point that there are types of I/C engines other than the complex multi-cylinder varieties which may encourage more model engineers to try their hand at this branch of our hobby.

The Gas Turbine Builders Association stand was another with plenty of visitors round it for most of the show and as usual they had a good display of engines with several sets of components to illustrate how a gas turbine is screwed together.

A wide field of influence. The map on the Southern Federation of MES stand

The highlight for many visitors was no doubt the chance to see Tim Coles' GT3 locomotive running on the North London Society portable track outside. This showed that these engines are not just demonstration tools, they really can do some work, particularly when Tim hauled our recently retired Editor, Mike Chrisp up the track.

The Ruislip Lido Railway stand was larger than last year and had lots more information and 'goodies' available for visitors which certainly appeared to generate a lot of interest and hopefully a financial boost for the group.

The National $2^{1}/_{2}$" Gauge Association had a good-sized stand with many locomotives, both part built and complete on display. One that caught my eye was the *Ayesha* revival project which had two, part built examples of the new version of this LBSC locomotive on the stand. The society will have castings available for this famous model once the design is proved. Another unusual and impressive locomotive was the New Zealand Railways Ab class 4-6-2, also under construction.

First Floor

So, up onto the first floor to the 'Sandown View' to be greeted by the 'Whiteleaf Light Railway' operated by the Buckinghamshire Garden Railway Society. This is always a big attraction to the children (both large and small) with plenty going on all the time and a wide variety of trains running.

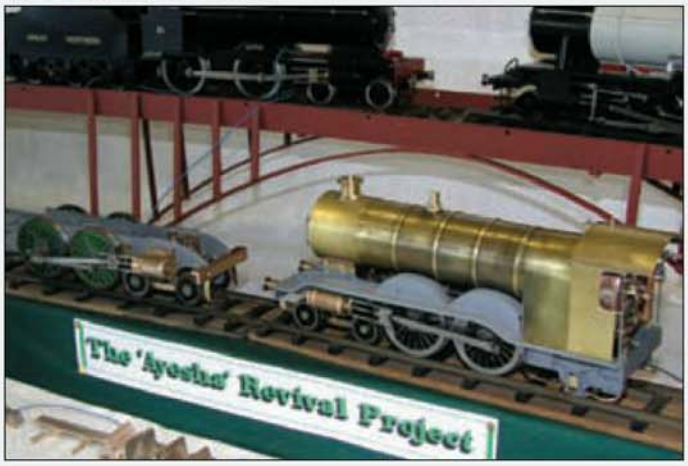
Close by was another a very busy stand, that of the Society of Ornamental Turners which showed some very fine examples of their work and tooling. At least two demonstrations were going on most of the time and as usual they attracted a huge amount of interest. This stand took the Best Club Stand Award this year not least because of the amount of effort those on the stand made to respond to all the questions arising from their demonstrations.

Tucked away near the previous stand were Kew Bridge Museum with a nice display of publicity material and some excellent model beam and stationary steam engines also on display.

Carrying on past the 'ride on railway' which was proving popular with the youngsters I came to the GWR Preservation Group. This society had a lot of information about their activities in Southall to the west of London and were busy raising funds with all sorts of items on sale in anticipation of

Seen on the I/C Engine Builders Group stand was this part built model of a Napier 'Dagger VIII' H24 engine.

Also on the ground floor annex was the Ruislip Lido Railway stand with lots to tempt the visitors.



A famous old locomotive design from the LBSC stable was being revived on the 2$^1/_2$" Gauge Association stand

Popular with children of all ages was the Whiteleaf Light Railway operated by the Buckinghamshire Garden Railway Society.

their successful negotiations regarding occupancy of the former Diesel Depot at Southall.

The next stand is an unusual society in that it is devoted to bettering the lot of others less fortunate than the majority of our readers. This is REMAP whose volunteers spend their time applying their engineering skills to developing or adapting *"equipment for disabled people where no suitable item is available commercially"*. It was interesting talking to those on the stand to discover just how much a part of the health service these groups have become and I am sure those who have gained that small amount of extra independence due to the organisation's efforts are very glad that there are still people around with such skills. I wonder what will be the situation in years to come with the increasing demise of practical engineering skills?

Continuous demonstrations took place on the Society of Ornamental Turners' stand.

It was then time to move round the lecture room and into the Club Room or to give it its official name The Solario Suite, which had been taken over by a variety of societies. In order to avoid any accusations of favouritism, I will tour the stands in clockwise order from the lecture room doorway.

The first stand to be visited was that of the North London SME who had a very varied display of models including the very impressive LBSC original 2$^1/_2$in. gauge 2-6-6-4 Mallet locomotive *Annabel* now owned by Jim Robson and featured in this magazine last October. There was also an unusual display in recognition of Mike Chrisp who is an active member of the society. A selection of Mike's favourite cover photographs from this magazine were displayed on the stand backdrop. I am sure many visitors spent time as I did remembering the photographs when they first appeared on the magazine cover.

The next stand, the Meccano Modellers Association must have brought early memories flooding back for many readers and also confounded those who were under the impression that *"you can't buy Meccano any more"*. One of the problems with this stand was that some of the items changed each day, so depending when you visited you may or may not recall the items I saw. Among these were the renowned block setting crane, surely the dream of many a youngster in years gone by. One thing I thought showed up the benefits of using Meccano for experimental work was the automatic gearboxes and differentials being displayed. On the last day an enormous boring mill appeared along with a Morgan Super Sports 3-wheeler car and a Brough Superior motorcycle both superbly executed in this most versatile of constructional systems.

The Association of Model Barge Owners provided a change of tack (excuse the sailing pun) with a fine display of fully working Thames sailing barge models. These brought back personal memories of school days in Essex in the 60s when several of these vessels were regularly to be seen in the estuaries along the coast. It was interesting to see the part built models on display which gave visitors a good insight into the work involved in building these models.

A fine range of models mingled with publicity material on the Kew Bridge Museum stand.

The well stocked GWR Preservation Group stand aimed to raise funds for their projects.

Model engineers who wish can help those less fortunate than themselves through membership of REMAP.

The North London SME stand paid tribute to retiring editor Mike Chrisp who is an active member of this society.

A timely reminder, if any was needed, of the versatility of Meccano as a model making medium.

A regular exhibitor at this show is Malden DSME who had their display set up alongside the previous stand. As we have come to expect from this local club, there was a wide variety of models on the stand including several under construction. I particularly liked Alan Rowell's fine launch engine which had a wealth of detail incorporated.

The next stand was that of the Lynton & Barnstaple Railway Trust who are *"committed to restoring as much as possible of the original line"*. They had a good selection of items for sale to raise funds and a wide selection of photographs of their work. The society reported that they have reopened Woody-Bay station to the public with passenger carrying trains.

In the next corner of the hall was a new society to the show, Reading SME who was exhibiting for the first time. Since this is my 'home' club I will have to tread carefully to avoid any accusations of bias either way! Having said that, I think all visitors will agree that the club did themselves proud on their first exhibition with a very varied and well laid out display of models. The range included several I/C engines, locomotives of several gauges, stationary steam engines, some fine '0' gauge buildings, a part built traction engine, a driving truck bogie, a tool and cutter grinder and a Hipp clock (the last by Les Dawson and working throughout the show). An unusual engine was the Aermotor 8-stroke I/C engine (only just completed before the show) by Alan Thatcher and now running well.

Next to Reading was the Napier Power Heritage Trust with their fine display of historical information, photos and models illustrating the wide impact of this company in many areas of transportation. Having started my model engineering with boats, I liked the air sea rescue launch on the stand. It was also interesting to examine the gas turbine engine displayed for the visitors who could also examine several drawings of Napier products and see the hidden complexity of these power units.

Staines SME had a very neat and compact stand with a proper canopy over the top. This was

A reminder of less hectic times on the Association of Model Barge Owners well laid out stand.

Something for everyone on the Malden DSME stand. Nice to see some part finished models with the detail still visible.

Lynton & Barnstaple Railway Trust had travelled a long way to promote their preservation activities.

The well stocked Reading SME stand was a welcome newcomer to the Model Engineer Exhibition.

The firm of D. Napier and Son was once a force to be reckoned with on land sea and in the air.

A neat Quorn tool and cutter grinder and its equipment on the Staines SME stand caught the eye of your contributor.

again filled with a good display of models and other items for the visitors to admire. Many of our younger visitors will have liked the 'gentleman' driving the small gauge train backwards and forwards along the top of the stand. I particularly admired the superb tool and cutter grinder with a full set of accessories in a fitted case.

What can one say about the next group, the Stirling Engine Society? They always have a wide selection of different engines on display, many doing useful work. This year was no exception with engines driving fans, workshops and vehicles (although the latter not moving) and operating at high temperature, low temperature and a variety of pressures. Those interested in this branch of engineering will be delighted to know that a new book on the subject by 'guru' Roy Darlington is to be published soon.

Last but by no means least on our tour, we come to the Guildford MES stand which again had a very wide ranging display of models on show. These included a musical wind instrument by Roger Curtis, In this case a 'Cornamuse' (described as a straight Crumhorn for those in the know). Roger also had his first locomotive model on the stand in the form of a 5in. gauge 'Terrier' tank engine. The other model that caught my eye was the freelance 16mm Narrow Gauge 2-truck Shay locomotive by Roger Hayward.

Well that concludes our tour for another year and as usual I must extend our sincere thanks to all those clubs who put in the effort to bring and man the stands. It is not any easy task particularly with the pressures on all of us around Christmas but as is usual with these things, many hands make light work. It was interesting talking to members of my own club for whom this was their first experience of the exhibition and although I sensed some doubts beforehand this had changed to the exact opposite at the end, so much so that they have booked their space for next year already. How about some other clubs giving it a try next year? The more the merrier and you would all be very welcome.

Roy Darlington (left) and a colleague keep watch over their fine range of hot air engines and related hardware.

Roger Hayward's 16mm narrow gauge 2-truck Shay was one of many fine exhibits on the Guildford MES stand.

THE BL 5.5 inch MEDIUM GUN

David Wilcox
concludes the description of his model and details the gun barrel, the breech, the trail, the sights and loading tray.

●*Part III continued from page 457 (M.E. 4245, 15 April 2005)*

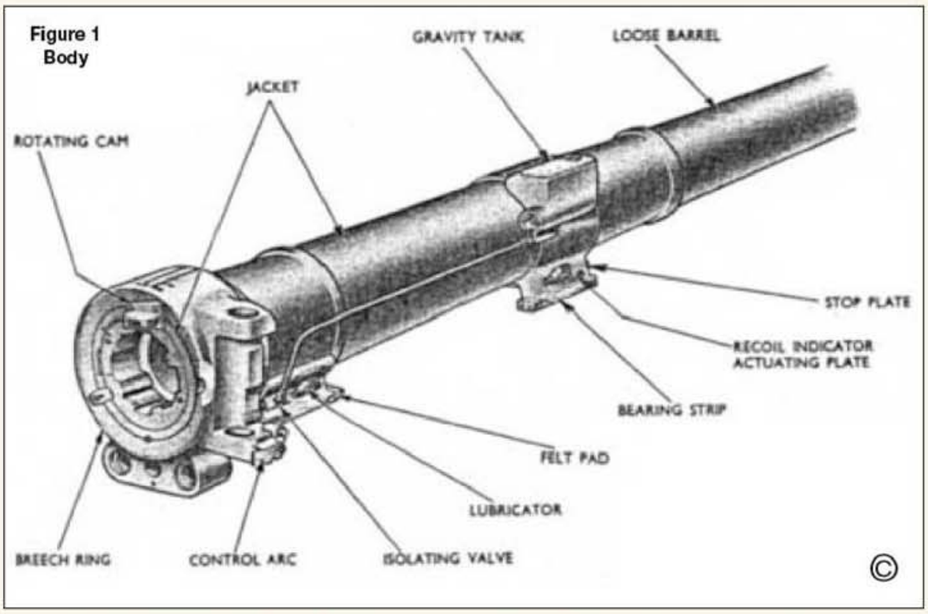


Figure 1
Body

The gun itself is shown in drawing 4 and **fig 1**. The gun comprises the barrel, breech ring and mechanism, the gun and cylinder block guides and the gravity tank to lubricate the slides. The barrel was turned and bored from two pieces of Duralumin rod and spigoted together using 601 retainer. The guides and the oil tank were filed very carefully to shape from brass or Dural and then bonded to the barrel with epoxy plus rivet reinforcement. The barrel and its guides should be able slide freely in the channels in the cradle.

Breech

The breech ring was turned from brass, the front bored to accept the back end of the barrel and the rear face to accept the annulus which incorporates the female part of the Welin interrupted screw thread. Next, a lug was silver-soldered to the breech ring to form the hinges for the Ashbury breech mechanism. Figure 1 and drawing 4 show the shape to which the lug must be milled and filed. Clearly some license has to be exercised in modelling the breech mechanism and some of the detail

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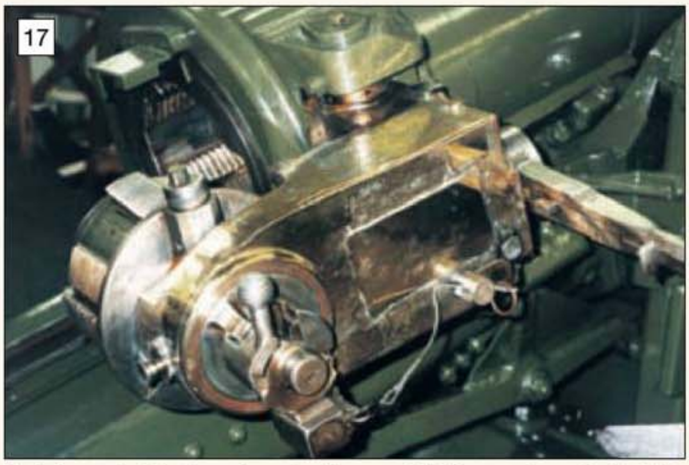
The breech ring with carrier frame and hinges shown with a 5 pence piece to give an idea of size.



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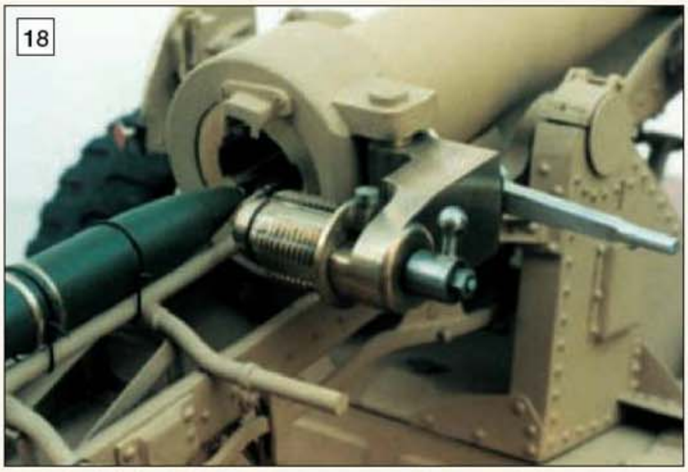
A photograph of the breech mechanism on a full size gun shown in the fully open position.



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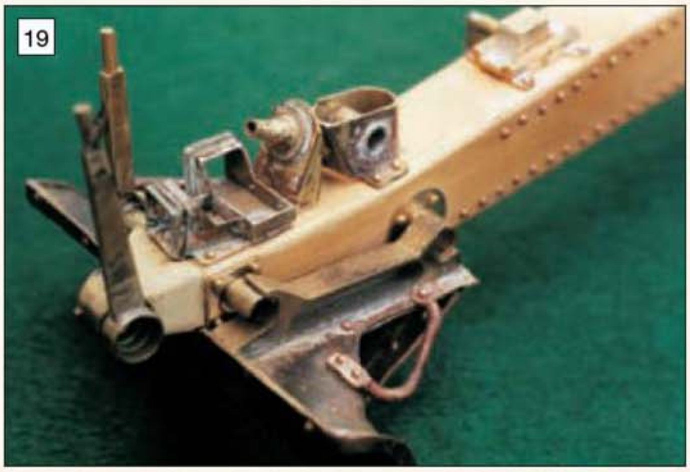
The breech mechanism as it appears on the model. The Welin stepped breech screw can be seen.



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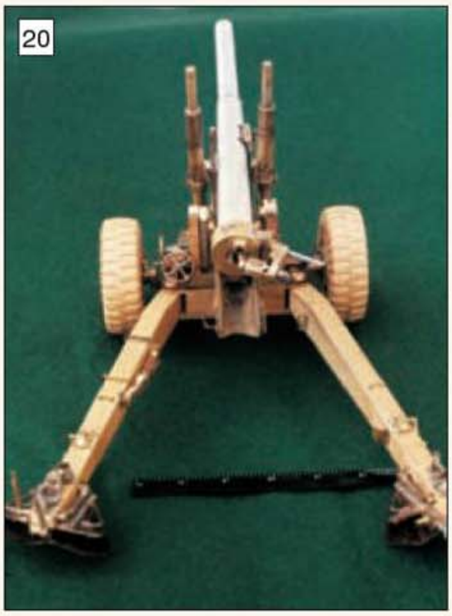
The left-hand leg detail including leg locking lever, spade locking lever, spade and hand spike sockets.



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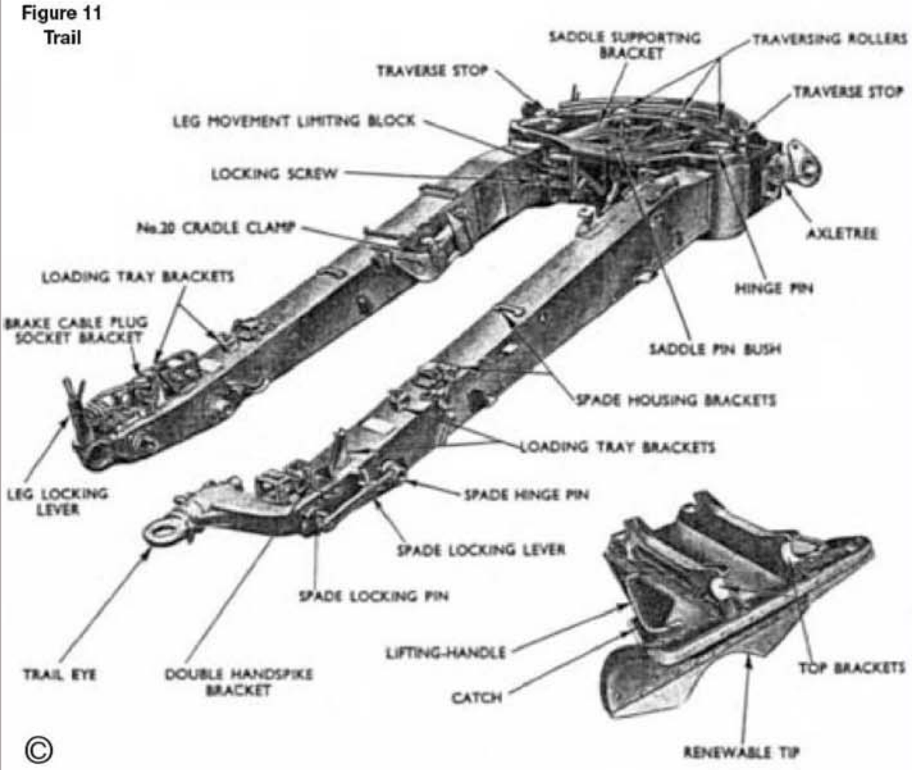
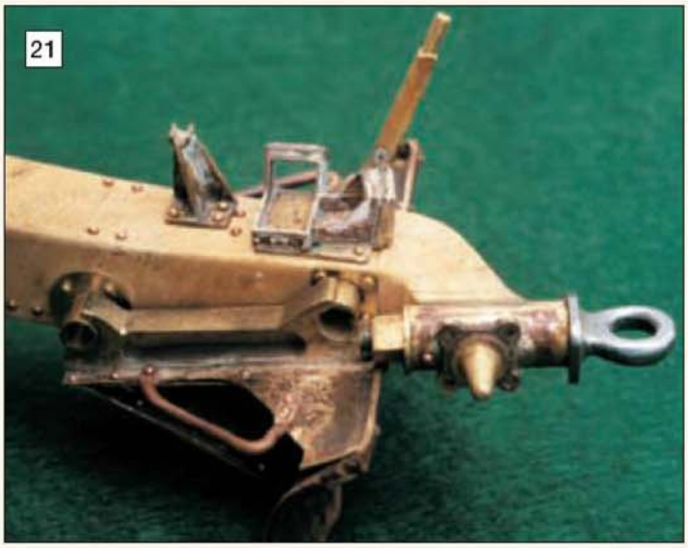
General view of the model gun before painting. It is in the firing position with legs apart.

Figure 11
Trail



simplified, particularly the fittings to the carrier frame shown in **fig 4** which is also carved out of a piece of brass. The Welin breech screw is able to rotate within the carrier frame and is turned by the LBM (lever breech mechanism) via a bevel gear in the act of opening and closing the breech. **Photograph 16** shows the breech ring and carrier frame hinges. The lug on the underside of the breech ring provides the anchor for the buffer and recuperator piston rods. This was filed and drilled to shape and then bonded in place with epoxy. The Welin interrupted screw breech mechanism, which I made for this gun, was the subject of a previous article published in *M.E.* 4181, 1 November 2002 so is not described in detail here. Suffice to say that this system uses stepped screws requiring the breech screw to be turned through 30deg. to lock and unlock. This is achieved through operation of the Ashbury mechanism housed in the carrier frame. **Photograph 17** shows the actual mechanism and **photo 18** the modelled mechanism. As a matter of interest, this system was also common to the Royal Navy's 6in. gun which was the armament of some Second World War cruisers.



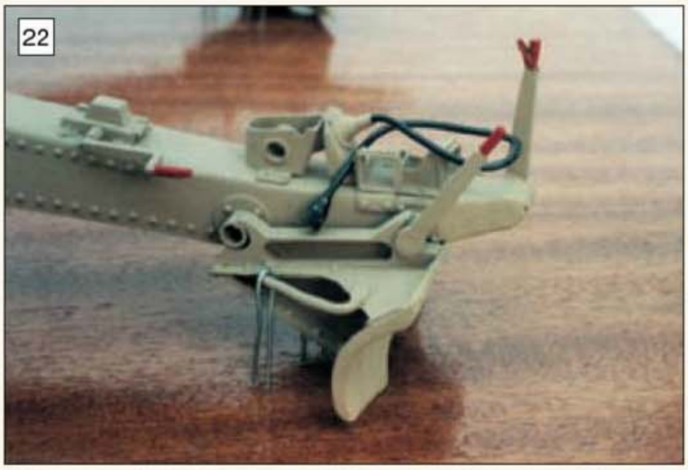
21

Detail of the right-hand leg of the model showing the spade, leg locking spigot and the trail eye

Trail

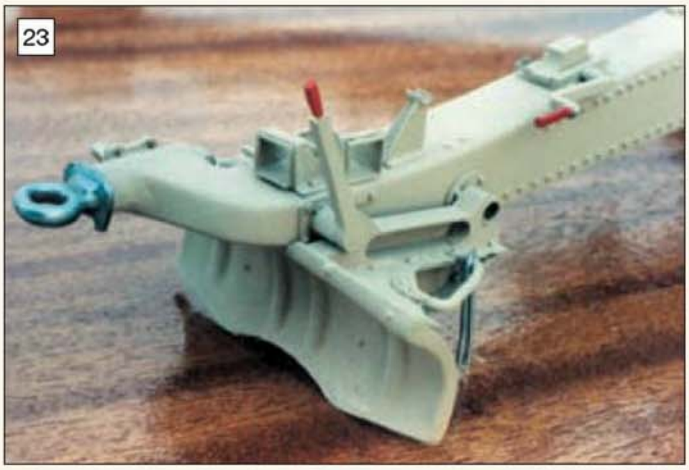
The trail consists of two carriage legs, which lock together for travelling or are splayed at an angle of 60deg. apart for firing as seen in **photo 20**. Each leg has a number of fittings and these are shown in **fig 11** and **photos 19** and **21** before painting and **photos 22** and **23** after painting. The function of many of the fittings is self-evident but some need a little elaboration: -

1: Legs. These are each made from a single piece of boxwood. Rivets were used to secure most of the fabricated details to the legs and several hundred $^{1}/_{32}$in. dia. rivets were used to simulate the rivetted construction of the trail.



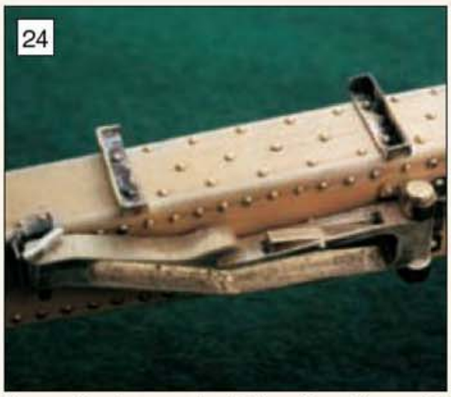
22

Detail of the left-hand leg after painting in appropriate desert warfare colours. The red handles can be regarded as 'gunner's bull'.



23

The right-hand leg after painting. An alternative colour for the gun would be olive green.



The cradle clamp on the left-hand leg. The model portrays the rivetted type of carriage and some of the simulated rivets can be seen.

2: Cradle Clamp. For travelling, this swings over to lock with the right-hand leg. The gun and cradle are then elevated until the lug at the bottom rear end of the cradle locks with the clamp for travelling. The clamp is shown in **photo 24**.

3: Spades. These fit to the underside of the ends of the legs via brackets on the tops of the spades and the short tubular protuberance on either side of the legs. Spade locking levers on the outside of each leg lock the spades in place during action. For travelling, the spades are removed and locked into the spade housing brackets on the top of each leg. In the model, the spades were fabricated from brass sections and copper sheet; the latter annealed and hammered over a hardwood former so as to achieve the correct curved and swaged shape. At 1:15 scale, $^1/_{32}$in. dia. rivets appear to be exactly right.

4: Leg Locking. For travelling, the legs lock together via a cone-shaped spigot and recess, the spigot in the left-hand leg and the recess in the right-hand leg. A lever locks the two together.

5: Hand spike sockets. Hand spikes are used to help lift the trail legs either when bringing the gun into action or to shift the 60deg. arc to another direction. On each leg there are two hand spike brackets at right angles to each other, fabricated in the model from silver-soldered brass and copper sheet. Incidentally, as often as not, I use copper sheet rather than brass for small detailed parts since it is less likely to be damaged by overheating when silver-soldering and is easier to shape.

A view of the left-hand side of the saddle on the model showing the finished sighting system.

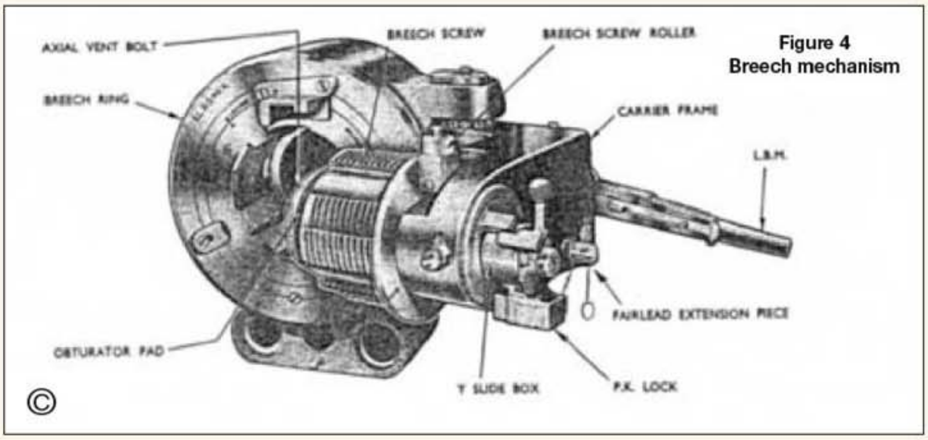


Figure 4
Breech mechanism

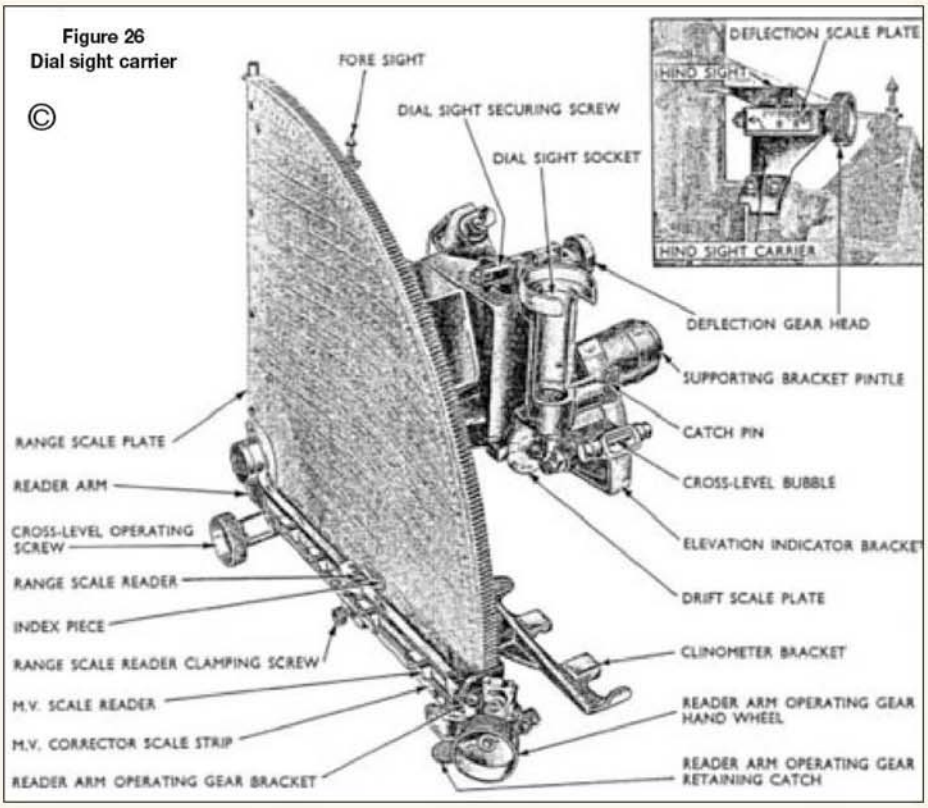
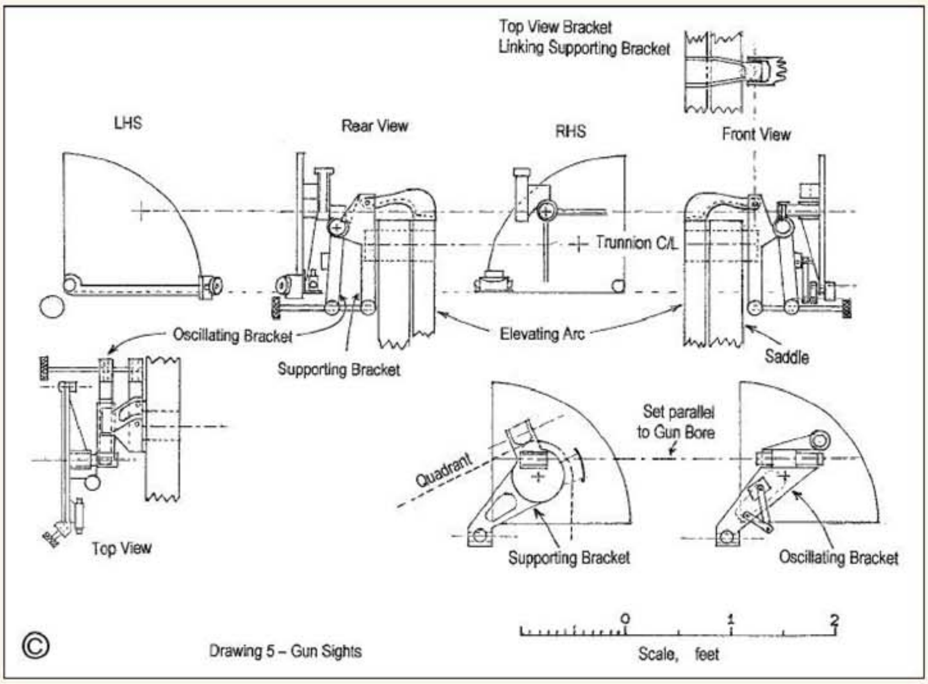
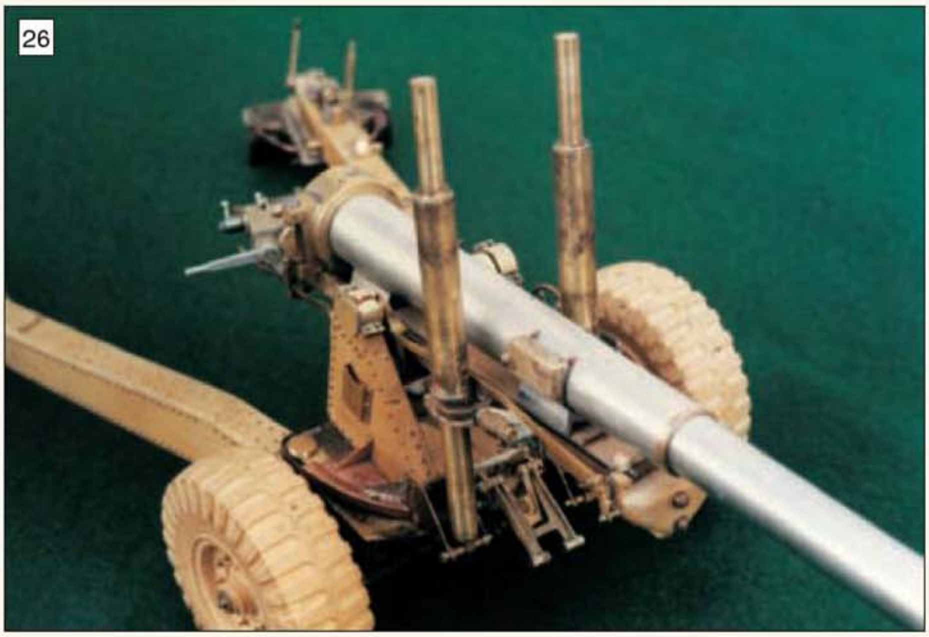


Figure 26
Dial sight carrier



Drawing 5 – Gun Sights



Above: A general view of the finished model prior to painting. The balance spring horns are a characteristic feature of this gun.

Above right: A gunner's-eye view of the finish painted model. Notice the shell ready to load.

6: Towing eye. This was carved out of a piece of mild steel and the eye highly polished. The eye should be able to swivel.

Sights

The 5.5in. gun is primarily intended for indirect fire, i.e. the target is not visible from the gun. The sights enable

1: The gun to be elevated to achieve the range set on the range scale, taking account of the cross level. If the gun is on uneven ground such that the trunnion axis is not horizontal, this has to be allowed for.

2: The angle of sight to the target to be set. The gun is almost certain to be at a different height above mean sea level to the target.

3: The gun to be pointed in the desired direction or azimuth using a dial sight. There is also a direct fire sight.

The sights are shown in **drawing 5, fig 26** and **27** and also appear in **photo 25**. They look a bit complicated and there are many odd-shaped pieces linked together and I do not intend to describe how it all works in this article. At 1:15 scale it is possible to make a generally representative set of sights but I do recommend that anyone attempting this should examine a gun and take photographs. My drawings will at least provide the correct dimensions.

Loading tray

This is shown in **fig 41** and in photo 18. The tray with shell is lifted into the cradle trough prior to ramming the shell into the breech.

Painting

I painted my model desert sand colour since the gun first saw service in the Western Desert in 1942. Olive green is equally appropriate. Certain details are painted red (call it Royal Artillery 'bull' if you like), notably various handles. The tow eye, bearing and elevation hand wheel rims, the LBM and other moving parts of the breech are polished metal finish. **Photographs 26** and **27** show general views of the gun before and after painting.

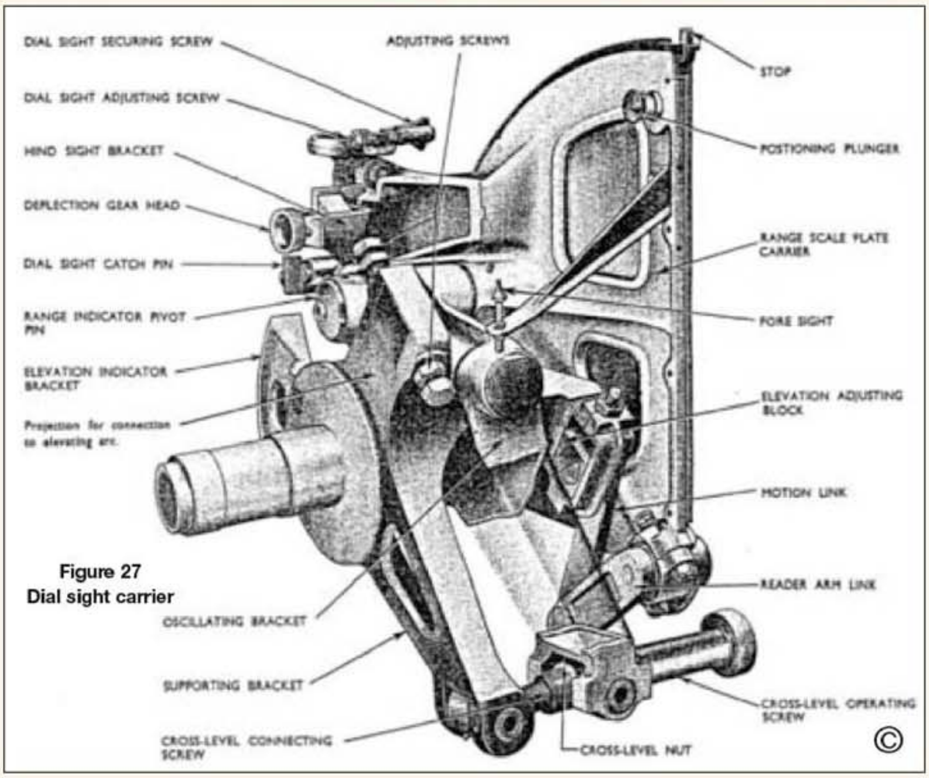


Figure 27
Dial sight carrier

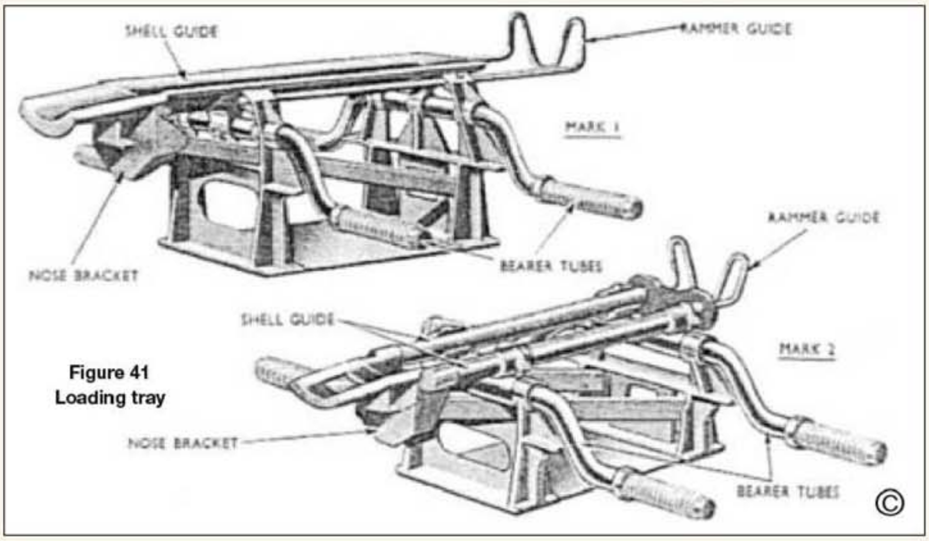


Figure 41
Loading tray

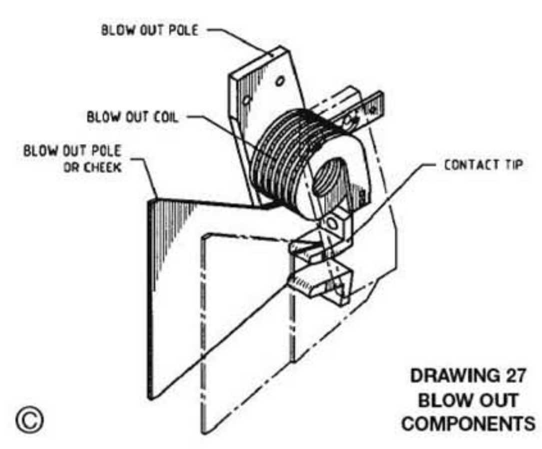
ELECTRO-PNEUMATIC CONTACTORS

Colin Beckwith

continues with some notes on the jigs he uses before discussing arc control.

●*Part VII continued from page 439 (M.E. 4245, 15 April 2005)*

The jigs so casually mentioned are not sophisticated fixtures but just drilling guides often secured with small clamps. They are what could be said to be a minimalist solution, but are functional and effective. They save much time by elimination of marking out and give reasonable, repeatable accuracy. Usually made from bright mild steel (BMS) they include registration abutments, which improve stability once clamped and during drilling. Elsewhere I have mentioned jigs in specific instances of relevance throughout the article. The jigs being made of BMS are subject to a bit of wear. I could have spent more time on them and made them more user friendly by including clamps in their design. Also I could have made them from a tougher material like gauge plate or ground flat stock. The reason for doing it the way I did was to minimise the manufacturing time of these items. The material selection was deemed adequate for the perceived production cycle, it being only a few pieces.



DRAWING 27 BLOW OUT COMPONENTS

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Arc

When the current flow in a circuit is forced to stop via a mechanical switch with an air gap, an arc is formed. This will happen unless the supply voltage and current are minimal, that is below so-called arc threshold. This arc threshold is much too low to be of use in this application, indeed many others also. It is predicted that with a line voltage of 48 Volts and current of anything up to 75 Amperes, arcing will need to be controlled. Any arc can be destructive, low energy ones less significantly so, but over time they will all take their toll on switch contacts. Arcs that occur in traction applications can be very destructive and almost frightening. Consider lightning for instance and how awesome thunderstorms are in sound and appearance. Contactors on full size traction applications will have to clear circuits carrying large currents. The manifestation of this duty does not stay silent or remain invisible to railway passengers. This is because the power contactors for most multiple units, for instance, are below floor level, including the so-called line breakers. As described above these devices switch the traction motors and clear faults. When they do this a long arc is formed lasting only a split second before being extinguished. This gives rise to a bright blue flash and a loud pop. If you have ever stood next to this, at platform level, when it happens it can make you jump especially if it is a surprise.

A basic physical phenomenon is exploited to control this arc and hence limit the damage to the apparatus over its life cycle. This, when applied to air break switches and circuit breakers, works by means of the interaction of magnetic fields. These magnetic fields are associated with the arc as well as the blow out coil. The arc is actually pushed away from the contacts by a force imparted on it from the blow out coil. This lengthens the arc until it is no longer able to sustain itself and the arc is thus extinguished. This interaction between magnetic fields is similar to that which causes an electric motor to rotate and it is illustrated in **diagram 2**. The arc is further controlled by way of its temperature. The blow out coil pushes the very hot arc into an insulated box or arc chute, which can have features which cool the arc. Cooling also results in arc instability and will cause it to extinguish more quickly. The arc chute construction is described later on.

The duration of the arc has to be optimised in that, if it lasts too long, burning will occur at the arc roots. However, if extinguished too rapidly the current transient or rate of change will cause the arc to re-strike, perhaps many times. Damage will ensue if either scenario is encountered. The idea is to lengthen the arc and so increase its voltage and reduce its temperature at a controlled rate until it is no longer sustainable. The magnetic flux produced by the blow out coil has a large influence on the time taken to clear an arc. It is therefore necessary to optimise the turns included in the blow out coil. This is achieved by testing which is expanded upon below.

Blow out coil

The blow out coil's job is to create a magnetic field with specific polarity and strength. It is connected in series with the main contact tips. That is to say, it will carry the main circuit current. In this way the magnetic field produced by the coil will always be proportional to the circuit current. The coil has an associated magnetic circuit that is arranged to create this magnetic field across the plane of the main contact tips. This is as shown in **drawing 27** and diagram 2. Note the direction of the coil winding as this has an implicit role in the function of the blow out coil. The name 'blow out coil' stems from the fact that its sole purpose is to seemingly blow out, albeit magnetically, the arc formed upon the main contact separation.

The final number of turns for the blow out coil has yet to be finalised and is a matter of establishing an empirical rule. The basis of this rule will be comprehensive testing under all current loads envisaged to occur in service. This is open to judgement of course, but certain headway can be made if the worst case scenario is established correctly. This is a matter of further development and, to this end, a test blow out coil has been constructed. The test coil consists of a coil of the same basic size, but with many more turns. The idea is to adjust the current to this coil for any single arc current value and thereby obtain a subjective opinion of interruption efficiency for each arcing current. The Ampere turns for the blow out coil would then have been established. It is then a simple matter of choosing the right coil section and juggling this with the turns then available until you get the most agreeable solution. A starting point is the optimum current density in the blow out coil

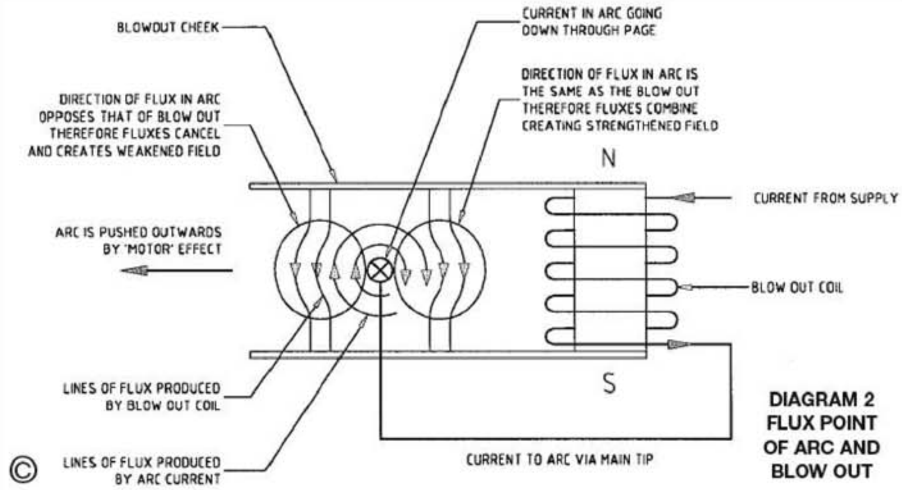

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DIAGRAM 2 FLUX POINT OF ARC AND BLOW OUT

The main contact tip shown left alongside the lower arc horn. The lower arc horn is not fabricated but machined and filed out of brass section.

More details of the contact tip and lower arc horn showing the piercing of the latter to improve cooling.

copper, this value being in the region of 3,900 Amps per square inch. In metric about 6 Amps per square millimetre. Given that I envisage using copper strip of 1 x 5mm the theoretical, continuous current for the contactor is 30 Amps. The current can and will rise and fall in line with what is happening to the train and this characteristic can be tolerated. During overload the situation can be very different. In a short circuit situation the potential current can be many times in excess of the continuous rating of the contactor. Current of several hundred Amps would be likely, so the contactor will have to open very quickly. For reasons mentioned earlier the EP contactor is well suited to this, but it still means that the blow out system will have to cope. Therefore the testing will have to cover all possible eventualities including low circuit current. as well as short circuit currents.

The contactor has been designed assuming a strip wound blow out coil, this is both sweated and rivetted to the fixed contact holder and terminal respectively. The coil thus forms an integral part of a sub-assembly joined semi-permanently. The inside of the blow out coil is stable enough to form the mounting for its mild steel core with the requisite insulation.

Simple electromagnetic forces

Reference to diagram 2 will show that there is a magnetic field associated with the arc. This magnetic field interacts with the field produced by the blow out coil described above. Reference to some basic theory will suffice to explain the situation. The diagram is seen from the top of the contactor. The current in the arc is indicated as flowing into the paper. Therefore the direction of the flux travel is clockwise as shown, by virtue of the 'cork screw rule'. The direction of the blow out flux is from top to bottom. Therefore, the field to the right of the arc as viewed, will be stronger than that to the left of the arc. The result is that the arc will be forced to the left, away from the contact tips. The force that is induced in the arc column as a result of this action can be calculated, but it is only of academic significance. The magnetic flux produced by the blow out coil is interposed around the arc using steel plates mounted inside the arc chute but insulated from the arc.

Main contact tips

The main contacts of the unit are subject to a great deal of wear and tear, such that they are intended to be of sacrificial nature. To this end, the contact tips are separate items being screwed to either the fixed or moving parts of the device. Each tip, whether fixed or moving, is exactly the same and are interchangeable albeit before they are used for the first time. Once they have been in service, they bed down and should not be disturbed until they become worn out. In fitting these items to the contactor it is helpful to have the air supply on. The tips can be fitted to their respective holders and the screws tightened partially. The solenoid valve is manually operated, which allows the contactor to close. Incidentally, great care must be taken here, not just to avoid trapping bits of or complete fingers, but to make sure that the traction current is isolated. Once the contacts touch and bed the tip screws can then be tightened. This operation ensures that the tips face together perfectly and do not rely on a point contact, which would cause overheating. This operation would be much more difficult to perfect on an electro-magnetic (EM) contactor. This is due to the difficulty in manually operating it, a further disadvantage of EM contactors. The main contact tip design is detailed in **drawing 23**. This drawing shows a more complex design, which was simplified for the build, however the design needs to be evaluated. The basic profile is the same for the unit built.

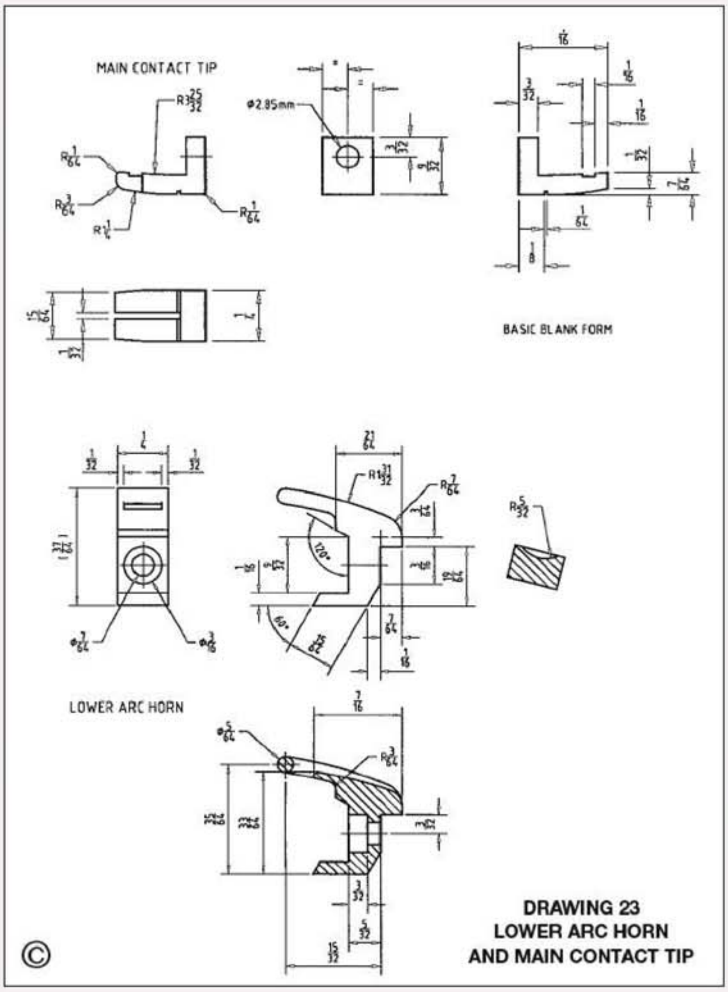
The ability to replace the key components of the device easily, gives a prolonged service life to the contactor. Many millions of operations can be perceived over the years that the unit is operational. This capitalises on the robust design of the contactor throughout many contact tip life cycles on it. The tips can be changed in a few minutes, even when the unit is installed in the locomotive, and can be done between runs out on the track.

The contact tips designed for electro-pneumatic (EP) and EM contactors of similar performance specification will differ in design. Frequently the contact tips for EM applications will be significantly wider. This is because the force on the contacts available is less than on the EP types. This means that the current density applied to the contact tips has to be less to inhibit overheating. The wider tips used on EM contactors have other implications which affect the design of the arc chute components. The poles for the blow out system have to be spaced further apart, which requires a greater value of Ampere turns on the blow out coil. This has significance when considering the overall size of the contactor.

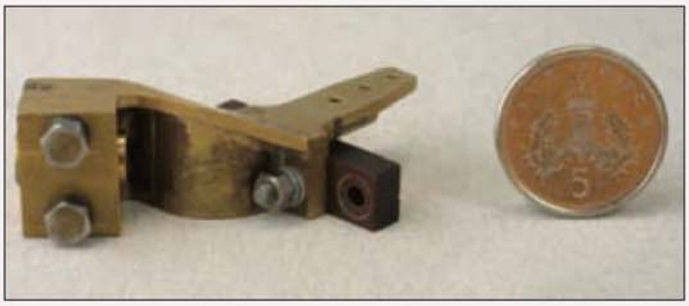
The tips are sawn and filed to shape out of hard drawn copper bar, which is superior to sheet material for this application. Of course the best solution would be to get the tip profile extruded as on the full size. They could then be just cut to length, which would be significantly better than cutting the profile to shape.

Limits of wear

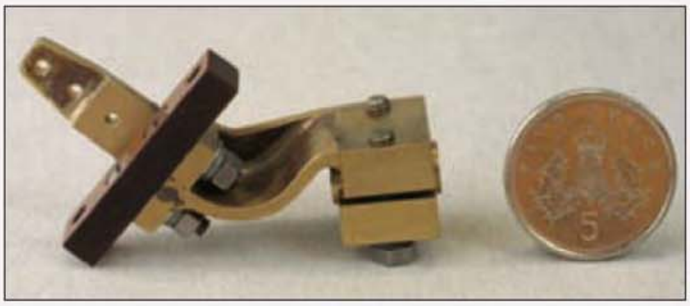
The contact tips cannot be allowed to wear beyond prescribed limits, amounting to an extra 1/32in. of piston travel overall. The main criteria with which to establish this limit is the contact pressure. As mentioned elsewhere, there is a



DRAWING 23
LOWER ARC HORN AND MAIN CONTACT TIP



The terminal for the fixed contact is shown with the power cable thimble clamp fitted.



The terminal mounting insulator fits on to the fixed contact clamps and can be seen in this view of the terminal assembly. Note blow out coil connection.

large opening spring mounted inside the operating cylinder. This spring has to be compressed each time the contactor closes. With a longer stroke, as is the case with worn contacts, this spring has to compress more. Reference to diagram 1 will illustrate this along with that mentioned previously. The total force available with an EP contactor still has more in reserve than an EM type. Even when the limits of contact wear are taken into account. The force limitation is shared by the EM contactor and is of more significance due to the limited force available from the operating coil.

The contact tips also need to have a degree of mechanical capacity in reserve. This is such that the effect of a wear rate of 1/64in. on each tip is of mechanical significance too. Even if the contact pressure constraint were insignificant, this mechanical limitation would prove important.

Excess piston travel will have an effect on the auxiliary contacts. The timing of these contacts closing with respect to that of the main tips is of critical importance. The result will be to make the action of the auxiliary contacts occur earlier than would be the case with new tips. A failure of the equipment to progress through its programmed sequence properly may then ensue. The manifestation being a repeating contactor, the term associated with rapid contactor cycling. The reasoning around this so-called repeating phenomena is described in the section on auxiliary contacts.

Arc horns

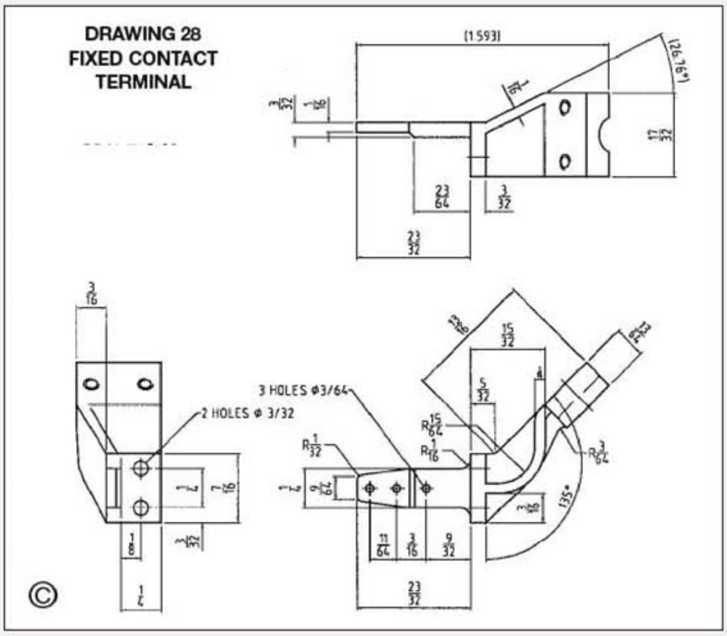
The job of these components whose locations are shown on drawing 4 is to assist the arc transfer from the main contact tips. The lower arc horn being detachable can be renewed when worn out and is shown on drawing 23. This will not be done as frequently as the main contact tips however. The upper arc horn is assisted by a small part, which can be classified as an arc horn. It goes in between the fixed contact tip and the fixed contact holder. It is detachable as it wears when the arc travels over it on its way to the main arc horn. The construction of the upper arc horn is covered on the fixed contact holder description.

The lower arc horn is a different kettle of fish and it makes the moving contact assembly quite bulky. This heavier construction is in part due to its shorter length. This exploits the tendency of the arc to rise due to its own heat. The down side of this is that the arc moves more slowly over this horn, hence the greater mass. The lower arc horn has to be removed in order to gain access to the moving contact tip. This is necessary when it is desired to change the main tips.

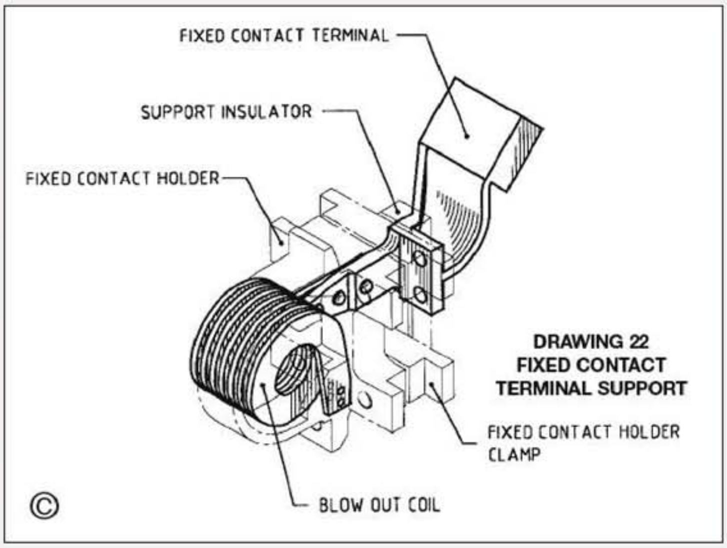
Main terminals

Fixed contact terminal

The fixed contact terminal connects the world outside of the contactor with the blow out coil and it is shown in **drawing 28**. The blow out coil end has an extension on it with three 3/64in. holes to take rivets to retain it to the coil. The coil is also drilled at this end. The lug and coil are then tinned with solder. The rivets are fitted and the joint is then sweated to finish the job. This ensures that a good electrical and mechanical connection at this junction. At the other end the terminal is angled upwards at 45deg. to the cable connection block. The cable used can be up to 10mm^2 but the optimum size is 6mm^2 both being terminated with a special thimble. The connection point is specially shaped to receive this thimble via a semi-circular cut out. The thimble is retained securely with the aid of a similarly shaped clamp secured with two, 6BA screws. The terminal is also compatible with flat copper straps or busbars, which tend to be used in favour of cable at certain locations. Indeed it is sometimes necessary to connect both cable and busbars to the contactors. This is possible with the layout chosen, although it has to be said that there would be simpler ways of doing the job. Still that would be too easy and not nearly as satisfying.



DRAWING 28 FIXED CONTACT TERMINAL



DRAWING 22 FIXED CONTACT TERMINAL SUPPORT

The terminal is mounted on an insulated bar which is further mounted on the main fixed contact carrier clamps. It is mounted very securely, due to the need to apply force to the cable terminals when connecting up the contactor. If the terminal was allowed to hang in the breeze, as it were, the joint with the blow out coil would be strained. This may give rise to irritating electrical faults, which are difficult to cure. The mounting arrangement is shown in **drawing 22** and also in various photographs.

The fixed contact terminal is a brass fabrication machined where necessary. It is one of the more taxing components to manufacture, which can be implied from the drawing. The fabrication is made from four separate parts, which have to be carefully shaped in order to fit together properly. As in the other brass fabrications the parts are doweled for stability during silver soldering. This was another one of those parts for which I was doubtful about its potential success. I have to say that it was less than ideal in practice, but still worked amazingly well. I think I was lucky.

● *To be continued.*

56

The housing for the rocking arm drive mechanism under construction using welding and brazing fabrication techniques.

57

The rocking arm drive system currently in use. Drive is by an electric pistol drill via a cardan shaft and thence to a worm and worm wheel assembly.

CAMCUTTER

A.J. Aldridge

continues with a description of the rocking arm drive mechanism.

● *Part XI continued from page 452 (M.E. 4245, 15 April 2005)*

From the outset there was a desire to have only one motor driving both the spindle and the work but this is not easy to arrange with a machine that allows the work and machining spindles to be able to come together in four different positions. The nearest I came to achieving this was with a Bowden cable drive using a 4mm wire but after snapping two and unwilling to put more money into what was becoming a lost cause I reluctantly accepted that a second motor would have to be employed. Having spent my money on flexible drives the purchase of a motor was put into abeyance until I could work out the correct size of motor, as it was obvious that my initial thoughts were an under requirement.

In the meantime a temporary expedient was pressed into service and, like so many things temporary, it looks like it will remain the driving method for the rocking arm. The simple attachment of a rough bracket to accept my portable drill and a short cardan shaft and I was in business. The drive is another worm and worm wheel, arrangement though not quite so fussy about the number of teeth this time though I did get it right first time. The housing box is a little more complicated on face value but once one gets into the swing it really is easy to assemble. The backing plate is turned to fit the spigot on the rocking arm **(fig 36)**. The offset hole need not be set out with the button method, as it does not hold anything in place. Make the worm and wheel using the same procedure as before includ-

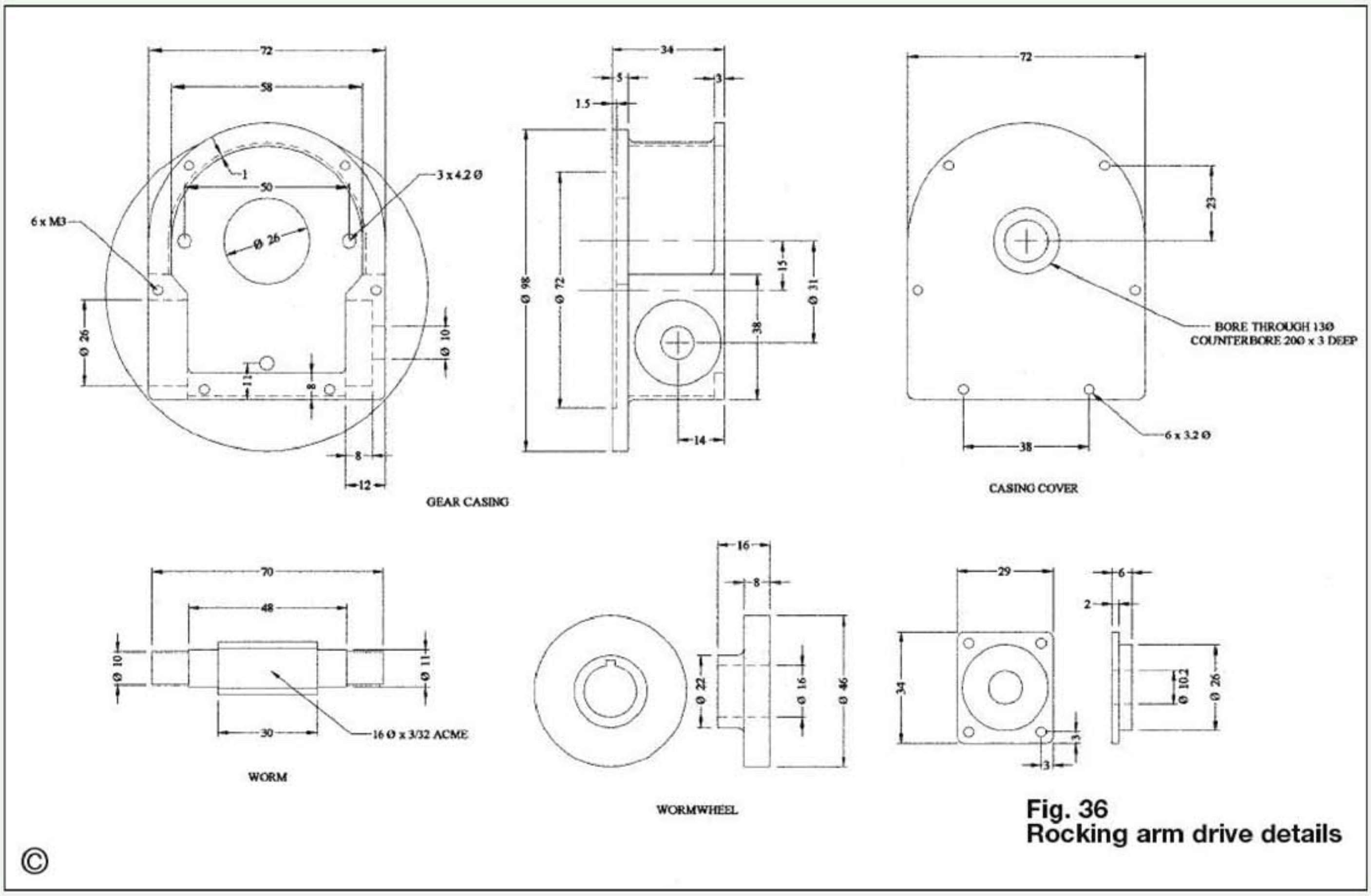


Fig. 36
Rocking arm drive details

ing the 'tap' or hob or hunt around the trade for something similar to drawing.

Assemble the box back plate to the rocking arm and have all the pieces of plate that constitute the sides of the box available to hand but not finished. The bottom sides will have been drilled and bored for the bearings and these can be pushed home. Put the worm and wheel into the assembly with the bottom, thicker side members and bearings on the worm shaft. Adjust the worm to worm wheel mesh with brass shim and clamp with a toolmaker's clamp. Tack weld the corners of the two plates and get the heat off as quickly as one can so as not to destroy the seals on the bearings. If you are not confident of doing this substitute two steel bushes for the bearings. Off the rocking arm the welds in the housing can be put in permanently. The wrap around top is formed and brazed into place followed by the flange carrying the fixing screws and generally the box is brazed and begins to take on shape. All the other bits and pieces can be made and tried in position especially the cover which is drilled for the shaft and tried to the job and then the hole pitching and outside shape is developed. **Photo 56** shows the work in progress. In **photo 57** the driving box is finished and fitted to the rocking arm though at this stage it still possessed the extra fittings to accept the Bowden cable, which can be seen at the cardan shaft connection.

The cardan shaft is another little exercise that appears to be difficult but as long as one approaches the job in a set way it is relatively easy to make and get good results from it. The trick, as I see it, is to get the size down so that the tiny shafts do not see large bending moments and at the same time the cross that forms the heart of the joint can still be threaded through the holes. The bushes are put into the clevises after the cross is in place and by some geometry one can find the minimum sizes allowable. I have not succeeded as well as I know is possible but the unit works satisfactorily in service. The cross is made from two pieces of silver steel, one is turned to have a middle section that requires careful drilling across its centre line and the other is plain piece of silver steel rod threaded through and silver-soldered in place.

Cross drilling can be done in a host of ways but I use the rule and pointer arrangement shown earlier. The silver-soldering takes care of the hardening as well and now requires tempering to light straw after cleaning up. Grind back very gently the ends equally to allow the cross to pass through the clevises. Make sure that there is no rag left by easing the corners. After this the placing and gluing in of the bushes and generally tidying up the outside is straightforward enough, but do not get glue on the shafting.

All Hooke's joints or cardan shafts have to have a sliding joint to take care of the apparent lengthening and shortening of the shaft line where there is misalignment and for the amateur the easiest, but not the prettiest, is to use square tube and a square bar. The tube will almost certainly need dressing internally to remove the welding bead but otherwise needs merely cutting to length. The sliding bar needs to be just that, a finger push fit to the tube. The connection of the clevises to the bar and tube can be by gluing or silver-soldering with attention paid to getting the end pieces concentric. For the tube a piece of bar is bored or reamed after setting up in the lathe to run the squares true to the centre line. The stub bar must be a good fit to the tube it pushes into. The sliding bar follows suit. The two ends of the cardan shaft must lie in the same planes for it to be a true constant velocity shaft. The cover is a piece of plain sheet with a hole through it to allow the shaft to come through which in turn allows one to knock out the centre.

The bracket still remains the lash up it was when force of circumstances decided that an alternative to the cable drive was imperative. The drive has been a 750 Watt portable electric drill but putting a meter on the line has shown that the power required appears to be about 250 Watt at 2500 rpm. I had intended to use a slower speed motor but watching the work piece turning I think that the running speed is about right as it is. The direction of rotation should be in opposition to the grinding wheel. If capacitor starters are used then the changing of rotational direction is simply a matter of moving two leads. Quarter horse motors are no smaller than the main motor and I am loath to use such a monster. Therefore I am looking for a suitable portable drilling machine I can convert that will be in keeping with the overall appearance of the rest of the machine. Until such time arrives the electric drill will have to suffice.

●*To be continued.*

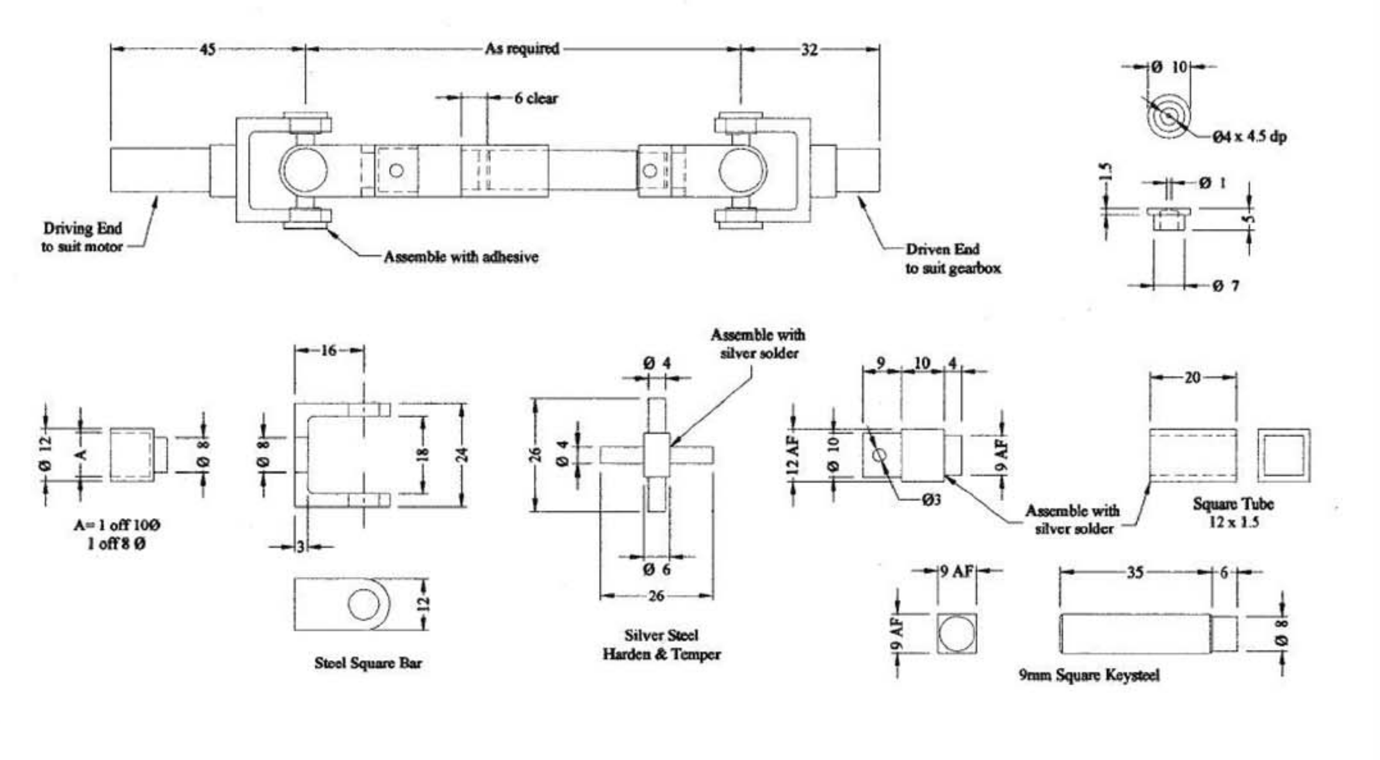
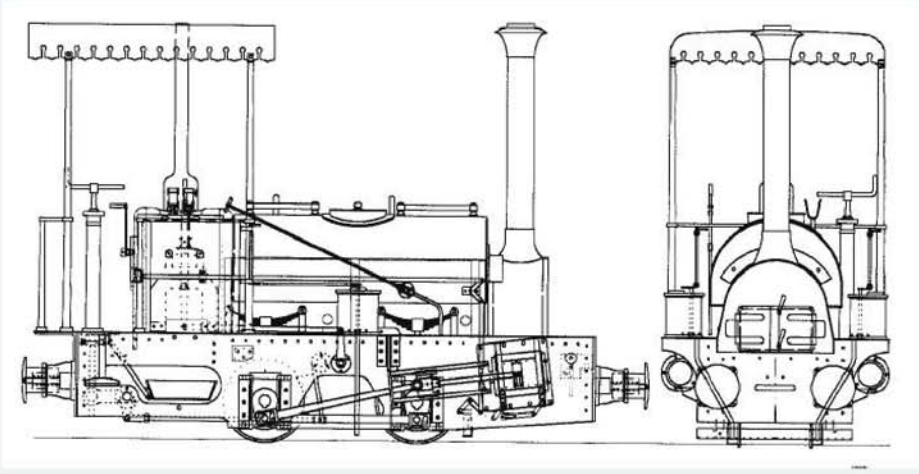


Fig. 37
Carden shaft and universal joint



ANNA

A MANNING WARDLE LOCOMOTIVE FOR $7^1/4$in. GAUGE

D.A.G. Brown and Mark Smithers begin with a little history before constructing the canopy.

●*Part XV continued from page 448 (M.E. 4245, 15 April 2005)*

Many commentators have expressed the view that one of the most attractive features of *Anna's* design is the distinctive fringed canopy. When one takes a look at the 18in. gauge Manning Wardle '6 by 8' class as a whole, it will be noted that, despite a period of construction that extended almost to the year of the company's demise, none of these locomotives ever acquired the typical post-1890s cab that one associates with a Boyne Engine Works product. The 'Woolwich' variety of the class, with its longer rear overhang, lent itself more easily to the fitting of an overall cab and *Arquebus* (1130 of 1889) was fitted with one of sorts when new, whilst others, including *Albert Edward* (482 of 1873) received them whilst at the Arsenal. The lack of full cabs on the 'Chatham' variant (the inspiration for *Anna*) must have been sorely felt in the Dockyard, as I can testify, having carried out field research there for my book *An Illustrated History of 18in. Gauge Steam Railways* on the coldest day in 1989!

Returning to that canopy, Manning Wardle were particularly fond of using fringed canopies for export products during the late 1860s and the 1870s. Examples of locomotives so fitted could be found in: Argentina, Brazil, Chile, Columbia, Cuba, India, New Zealand, Peru and probably Russia. One example, a 4ft. 4in. gauge 0-4-0ST *Olinda* (maker's number 1288) for Brazil was completed as late as 1894 but this probably embodied older 'stock' components. The main component of the canopy consisted of a sheet of iron rolled to the requisite profile with the fringes fretted into its longitudinal extremes. To this would be normally be secured shallow 'fore and aft' sheeting which could incorporate further fringes. The supporting stanchions from the Footplate would be arranged to line up with the centre, or 'point', of a canopy fringe. These would be secured to the canopy by means of L-pieces, the uprights of which would be attached to the sheet by means of a pair of rivets (see accompanying illustration of the Cuban survival).

Although no original 18in. gauge Manning Wardle 0-4-0STs are known to survive let alone a specimen with a fringed canopy (work has at last begun on a full-size replica of the 'Chatham' variant of the class), the survival in Cuba of a substantial portion of a 2ft. 6in. gauge Manning Wardle product of 1873 (believed to be works number 441) has given us the opportunity to illustrate the points put forward here and to bring into the discussion a character who apparently had an influence upon the design of the 18in. gauge locomotives. He is, none other than the well-known Victorian engineer, John Barraclough Fell (1815-1902). Fell is perhaps best known for his centre-rail grip systems, as exemplified by the Rimutaka Incline in New Zealand (1875-1955) and, for braking purposes only, the Mount Snaefell system on the Isle of Man. However, during the 1870s, he was very much taken with the idea of saving the cost of earthworks in railway construction by mounting as much of the railway as possible on elevated trestles. In the context of locomotive haulage, this was accomplished firstly by means of an 18in. gauge guide wheel assisted system at Aldershot in 1872-4 and shortly afterwards (under patents of 1873 and 1879) on the 2ft. 6in. gauge Pentewan Railway in Cornwall and the 3ft. gauge Torrington & Marland Railway in Devon. The locomotives initially employed on these railways were characterised by their low slung appearances and their long wheelbases, the latter to spread the load on the wooden trestles.

During the period 1870-5, Fell worked closely with Manning Wardle and although the '6 by 8s' were not designed with load spreading in mind (much of the track at Woolwich and Chatham being set into concrete), their low slung boilers would appear to have been the result of Fell's influence. Be that as it may, it is significant to note that much of Fell's work was overseas (he was involved with the temporary Mont Cenis Railway over the Alps, and also almost certainly with the Jaroslav & Vologda line in Russia). To quote dimensions for three relevant long wheelbase Manning Wardle designs (see table).

Number 461 was, of course, the well-known *Pentewan*, whilst 532/6 were for use in Sweden. Numbers 440/1 were supplied to the Bay of Havana Railway in Cuba and the latter of these locomotives was destined to enjoy a remarkable career. A new boiler was supplied by the makers in 1908 apparently coinciding with the engine's sale to the G. A. Manalich sugar mill following the Bay of Havana's conversion to standard gauge. Much modified (including the fitting of a dome to the 1908 boiler), 441 continued in service until the mid 1970s and even then its usefulness was not over. The 'rolling chassis' (sadly minus cylinders and part of the front end) was used in the construction of a diesel locomotive, with the top part of the canopy being cut back by about 25% and reversed. In this form the engine remained in use for a further two decades, surely one of the most remarkable stories in narrow gauge locomotive history. The chassis, together with the boiler and saddle tank (which had been dumped) have now ▶

Works No.	Wheel Arrangement	Wheelbase	Wheels	Cylinders	Gauge
440-1 of 1873	0-6-0 saddle tank	5ft. + 6ft.	2ft. 6in.	9.5 x 14in.	2ft. 6in.
461 of 1873	0-6-0 tender	5ft. + 5ft.	1ft. 8in.	7 x 12in.	2ft. 6in.
532/6 of 1875	0-6-0 side tank	5ft. + 7ft.	2ft. 7.5in.	11 x 16in.	3ft.


1

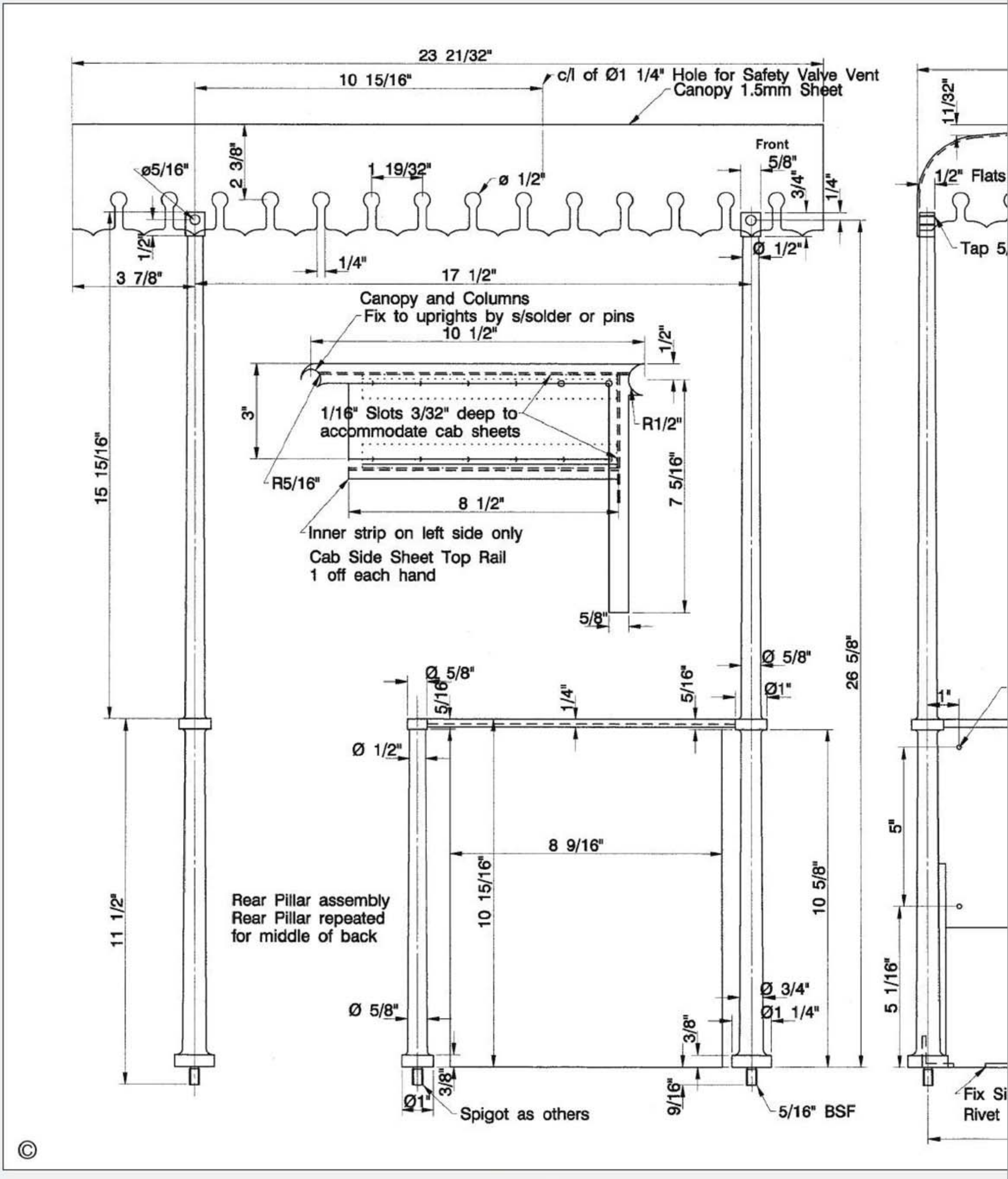
No. 441 - nature nearly swallowed the remains!


2

Shortened remains of No. 441's canopy.


3

No. 441's boiler recovered from dumping.

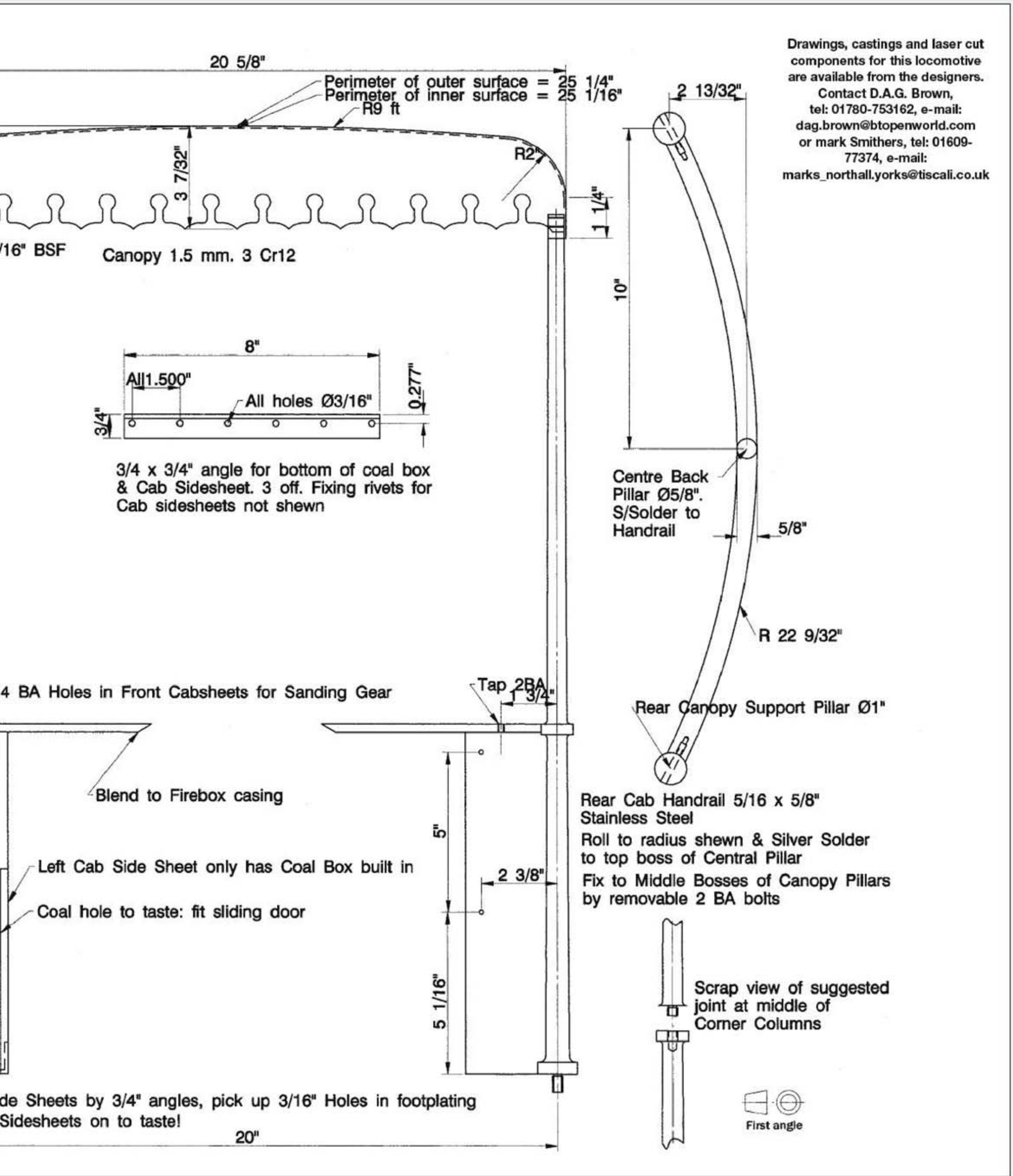


been recovered and stored, but it is only to be hoped that these components could be released at a future date for return to the UK where the expertise would exist to restore the locomotive to its former glory. In the meantime, photographs showing the relics in their current condition are reproduced (courtesy Christopher Walker) with this feature.

The Canopy (re-enter Derek)

Manufacture of this most important item gave an early fillip to the process of laser cutting, so let me explain what has been done. From the drawing you will see that 1.5mm thick material is involved for the two ends and the top and sides, which are rolled up in one piece. The laser copes with all the complicated frilly bits, making allowances at the corners for the slightly odd configuration of shapes which results from the sides sticking down slightly further than the end panels. A 5/16in. selvedge was applied right over the top of the end panels, so that slots (five in number) could be cut along the path of joint with the top panel; you can see from **photo 4** that the slots are placed one in the middle of the main

Drawings, castings and laser cut components for this locomotive are available from the designers. Contact D.A.G. Brown, tel: 01780-753162, e-mail: dag.brown@btopenworld.com or mark Smithers, tel: 01609-77374, e-mail: marks_northall.yorks@tiscali.co.uk



curve, one at each of its ends and one on each vertical section. Corresponding tabs were included on the outer ends of the top panel.

First roll the top panel to form the required curve of 2in. radius, which starts and finishes at the ends of the tabs (what a convenient marker!) I used an Edwards 3ft. bending rolls with 2in. dia. rolls, which after much sweat and many reversals of direction produced a very good curve of the correct radius. The basic problem here is that the 3Cr12 material is quite elastic and it only just takes up the required radius under these conditions; but it does happen after repeated rolling. The tabs on the ends of the sheet give the game away as the rolling process proceeds. After completion of the 2in. radius, the long radius is easily put on the top of the panel. When that is achieved the tabs should push into the slots with little persuasion, as shown in photo 4. It is now prudent to rivet over the ends of all tabs, so that nothing can move under distorting forces.

I am not the world's best welder, but I did find no difficulty in getting a satisfactory job with the MIG set around the insides of the joints. The

Three canopy components, tabbed and slotted.

The finished canopy after welding and dressing.

correct austenitic wire must be used and a colour check can easily be carried out on the outside to verify that satisfactory penetration has taken place. The weld is not visible after erection - it is necessary to remove the selvedge material, using an angle grinder or other brutal means - I finished up with a few minor gashes in the surface, but nothing that some body filler will not correct before painting. Please note that the laser has put in place the four fixing holes for the Pillars and the large hole near the centre of the top, through which the safety valve chimney discharges. The job was done so well by the laser that I have found it quite unnecessary even to touch any of the edges with a file. Quite honestly the longest bit of the whole job was setting up the rollers and forming the two 2in. radii. **Photograph 5** illustrates the final result.

Seven Pillars of Hercules

The Canopy is held up by four substantial Pillars, which are best made from stainless steel; in addition we shall need three shorter supports for the associated hand railing around the cab. The ancient Greeks knew a thing or two about their Pillars and introduced the concept of entasis to their shape: in order to correct an optical illusion that a tapering Pillar appears to be concave, a tiny amount of swelling is introduced into its middle, rather like a fat lady's calves! The result is that the Pillar appears to taper steadily from end to end. In our case I think this is too esoteric; nevertheless the fact that the design calls for different rates of taper top and bottom means that we may attain a degree of entasis without trying!

Just over 2ft. length is too much both for most lathes and would certainly require serious intermediate steadying during turning, besides wasting material. So, if you look at the scrap sketch at the bottom right corner of the drawing, you will see that I suggest splitting the Pillars at their knops, the two halves being screwed together and the top section incorporating its curved detail.

Considering the four main lower Pillar sections, it would seem easiest to turn the bulk of the length parallel, to its larger diameter of $^{3}/_{4}$in., perhaps putting in a step down to $^{11}/_{16}$in. dia. for half of the length. I do not have a taper turning slide long enough to cope with the $10^{1}/_{4}$in. which will eventually taper. Make sure that the short parallel 'collars' are faced nicely and drilled and tapped say $^{5}/_{16}$in. BSF, and with a countersink around that thread to afford tailstock support. The bottom end also needs a centre hole for 'tween centres mounting after the male thread is machined.

These Pillars must start from $1^{1}/_{4}$in. dia. bar and similarly those for the hand rail sections require 1in. dia. material, while the upper sections start life at $^{3}/_{4}$in. dia. Leave the tops of these at their stock diameter, but centred, until the taper is finished.

To form the tapers, it is worth doing all 11 sections as a batch, setting over the tailstock by 0.070in. or so towards you, so that the smaller end of the taper will be at the tailstock. Most tailstocks adjust by means of two opposed jacking screws, so that their barrels remain parallel to the lathe bed. To achieve the desired degree of taper, register a dial gauge from the cross-slide to the tailstock body and take up cross-slide backlash in the desired direction; note the gauge reading. After making your adjustment, wind the cross-slide until the gauge reads as before, at which juncture the amount of half-taper set will be directly given by the change in the cross-slide reading. Continue the adjustment until the desired offset is attained. Note that the overall length of the lower section is 11.500in. and the taper length is $10^{3}/_{8}$in. (inside the radii). So the actual amount by which the tailstock must be set over is 0.063 x 11.500 / 10.375 = 0.070 inch. If you maintain this offset for the other pieces, any error generated is so small that a blind man would like to see it.

It should be noted here that 'tween centres turning is inherently a less rigid set-up than handling the same material in a chuck. This is because, when supported between centres, the metal forms a simple beam, whereas the chuck restrains the material by forming a cantilever and the deflection under machining stresses is greatly reduced. Hence the need to restrict severely the depth of cut when turning between centres.

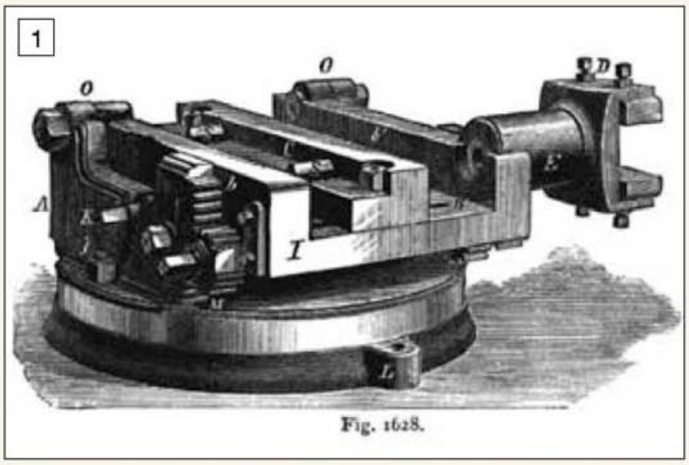
Remains of Locomotive No. 441 in Cuba.

Planting positions for all the Pillars have been determined already by holes in the Footplates, including three holes in the rear Footplate Extension. For driving it will be necessary to remove the rear cab Handrail, and I have suggested fixing the Handrail to the tall Pillars by means of removable 2BA bolts which can be lost in the ash-pit every time that the locomotive is steamed! Silver solder can be used to make fast the Centre Back Pillar to the handrail, because the Pillar is unscrewed from beneath the Footplate. To form the curved Handrail, roll up a piece of $^{5}/_{8}$ x $^{5}/_{16}$in. material, which is considerably longer than that required and be prepared to use heat if you cannot find someone in the trade prepared to lend a hand. Make use of the layout of the Footplate holes to chart progress and aim to get the $2^{13}/_{32}$in. offset within $^{1}/_{16}$ inch. Finish off by machining the end radii to fit the knops on the Pillars.

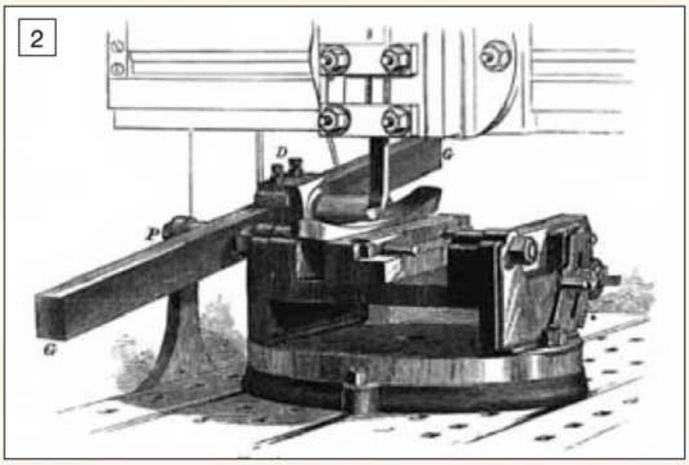
Three pieces of 20 x 20 angle are required to fix the right Cab Sheet and left Cab Sheet-cum-coal box to the Footplate. With the $^{3}/_{16}$in. dia. holes rather near to the web of the angles, you may consider spotfacing their inner surfaces and then using hexagon headed 2BA set-screws with their heads cropped to fit in the crook of the angles. They are fixed by nutting from under the Footplate.

The cab side sheets and coal-box door are available as 1mm 3Cr12 laser cut items, with holes formed for the sanding gear. You need to make a right angle bend at the places shown and this can be done either in a folding machine, or by local relief to half thickness, making a cut 0.020in. deep with an end mill inclined at 45 degrees. This will produce the perfect job for a neat bend and you can fit the Sheets into the slots milled into the middle of the lower edges of the Handrail sections of $^{1}/_{4}$ x $^{5}/_{8}$in. stainless material. Note the 2BA hole tapped into the top of the right-hand Rail; this accommodates the Pump Water Valve Support which was machined in Part XIV (*M.E.* 4245, 15 April 2005).

●*To be continued.*



The illustration in the book Modern Machine Shop Practice *that inspired the author to build the attachment described below.*



The attachment in Modern Machine Shop Practice *in use on a planer to generate a curved surface on a work piece.*

CUTTING CURVES ON THE SHAPING MACHINE

John Olsen
of New Zealand describes a novel attachment he built for his shaper.

Recently, I came across an engraving and a description of a special vice used for cutting large radii on a planer. This was in a book called *Modern Machine Shop Practice*. The book was written in 1887 by Joshua Rose and contains a wealth of information about machining practice of the times. Since it is out of copyright, it is available as a 'download' on the internet from the Michigan State University for no charge. The URL to locate the file is: -

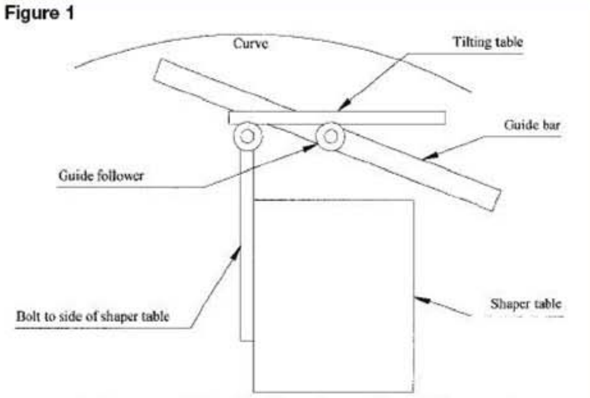
http://digital.lib.msu.edu/onlinecolls/collection.cfm?CID=10

I would like to take this opportunity of acknowledging the generosity of the University in scanning this work.

The vice is shown in the engraving, **photo 1**, and in use in **photo 2**. As may be seen the vice is hinged from the table at one end. The line of the vice jaws runs along the table and the angle of the vice relative to the table is controlled by a fixed slide beside the table. This engages with a follower at the free end of the vice. As the table slides back and forth, the free end of the vice is moved up and down. The result is that the tool cuts a curve on the object in the vice. I have not yet managed to establish what the equation of the curve is, but for the kind of lengths and radii likely to be required from the device it is close enough to a circle for all practical purposes.

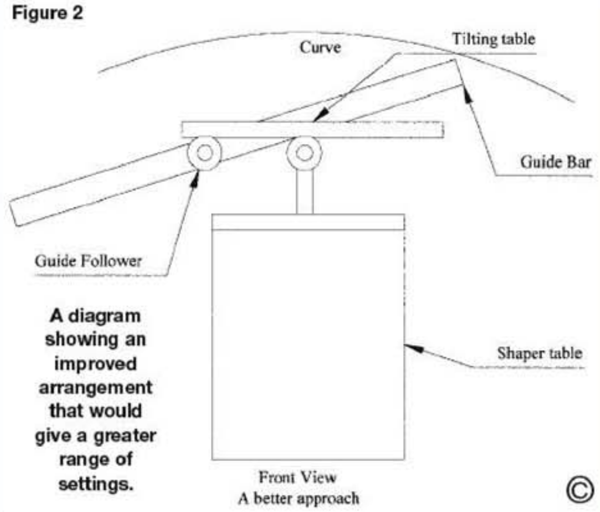
While this was interesting, few of us actually own planers. I wondered if the principle could be adapted to the shaper, of which I owned two at the time. They have since multiplied to four. Two methods of doing this occurred to me. One would be to use the back and forth movement of the ram to control either the angle of the vice, or possibly the position of the tool. This did not seem very feasible, since any mechanism would be 'up in the air' with no ready means of support. The other method involved providing a table pivoted on a line parallel to the movement of the ram by means of a hinge bolted to the standard table. The angled guide bar was then attached across the front of the main pedestal of the machine. Pictures being better than words for this kind of thing, the photos and sketches will give a better idea of what is involved.

Figure 1



© A diagram of the attachment used to cut the work piece seen in the photographs.

Figure 2

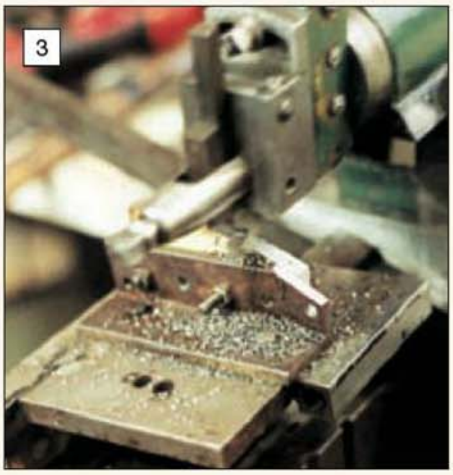


A diagram showing an improved arrangement that would give a greater range of settings. ©

Having spent some hours playing with the geometry attempting to derive the equation and then with a CAD program trying to empirically find if the curve was a circle, I decided that the proof of the pudding would have to be in the eating. I sorted through the scrap bin and found some suitable bits of material and welded up an experimental model (**figs 1** and **4**). Readers will note that there is no intention of exhibiting this at the Model Engineer Exhibition, which will go some way to explaining the lack of finish that may be observed! This was intended as a quick and dirty job to give me some experience of the possibilities and limitations of the method. In this it has succeeded, and now I know how I will proceed if I decide to make a more elegant model (**fig 2**). This is not all that likely to happen, since my workshop exists to support projects, not as a place in which to produce elegant tools. So I will only make a really nice one if I find that I have a sudden demand for a lot of large radius curves.

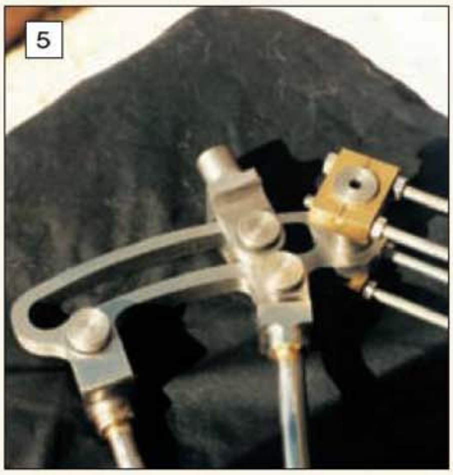
The basic structure consists of two plates. One is bolted to the side of the shaper table and has a piece of drilled square section material welded to the edge. The table itself is a similar piece of plate, with two matching pieces of drilled, square section steel welded to it. Alignment for welding was ensured by having the parts assembled during the welding process. This carries some risk that the parts would weld together or alternatively that the distortion from the welding would lock the whole things solid. In this case, I got away with it, although a hammer is needed to extract or replace the pin.

In retrospect, it might have been better if the hinge was at the centre of the table, although this would be harder



Cutting the convex outside curve on the expansion link.

Cutting the inside convex curve on the expansion link. Note the different mounting arrangement.



The finished expansion link after cleaning up with a fine file.

to arrange. The table is thick enough to permit drilling and tapping of mounting holes at any convenient location.

The arm to engage with the guide rail is supported by another piece of square section material welded in the middle of the table. Initially the piece at the opposite edge was used, but it was found that this gave too long a base line for the minimum radius desired. There is a relationship between the radius and the practical maximum length of curve that may be cut, since if the angle between the supplementary table and the guide rail becomes extreme, the table will not traverse easily.

The guide rail is supported on the pedestal of the machine by means of some parts made to match the dovetail there. Dovetails are of course easy to cut on a shaper, and these were even easier since they only had to have the end cut at the required angle. Check this whenever you make dovetails as not all machines use 60 degrees. Although the ways of the machine are hardened, I use brass shims here when clamping the attachment in place to avoid any risk to the slides.

There are two dimensions that determine the radius of the curve that will be produced. These are the distance from the hinge axis to the follower axis, and the angle of the guide rail. If the guide rail is horizontal, the radius will be infinity, giving a straight line. If the guide rail is set so that the right hand end of the job rises as the machine traverses to the left, you will cut a curve with the centre lying below the table. Conversely, if the right hand end of the job descends as the machine traverses to the left, you will get a curve that has the centre above the table. I did not find this especially intuitive until I had the device in front of me in action.

One job I was interested in trying the attachment for was a set of expansion links for a compound twin launch engine (**photos 3, 4 and 5**). These required a radius of seven and a half inches, over a distance of about four inches. For expansion links, we not only want to cut the radius on the top of the link, we also want to cut the slot inside with a matching radius on the top and bottom. This was accomplished with some special cutters. These were a piece of mild steel bar with a piece of $^3/_{16}$in. round, high speed steel (HSS) brazed into the end.

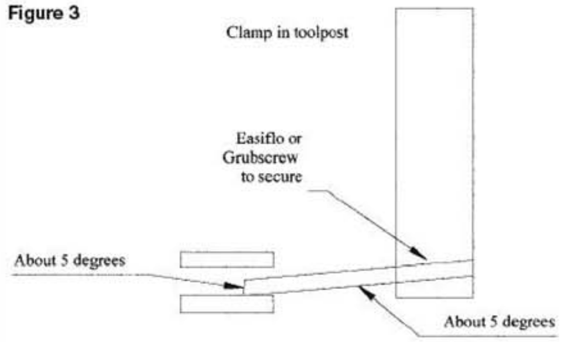
Note that a shaper owner's idea of a special cutter is something that takes more than five minutes to make up out of bits that are lying around. The length of the HSS had to be long enough to permit the slot to be cut through both links at once. One tool had the round piece sloping downwards (**fig 3**) to give clearance for cutting the bottom and the other had the clearance on the other angle to permit cutting the top. Actually I was mean and used the same piece for both, holding the bit in with a grub screw initially and brazing it for the second cut. While cutting the underside of the slot, the clapper box was left free to move, but for cutting the top of the slot it was locked. Ideally the clapper box would be inverted for that cut, but that is hardly practical, and the extra wear on the cutter for a job like this is not a problem. Before setting the blanks up, a pair of holes were accurately set out and drilled at the desired ends of the slot. Then the slot in between was started by drilling a series of holes along the length. It was not found necessary to file out the webs between the holes.

The job was set up between two pieces of angle iron on the special table, using the two holes with suitable pieces of round bar through them to assist with alignment. The two variables had previously been set to cut the correct radius by experimenting with test pieces.

It will be seen that a G-cramp is being used in the photo. This is because the range of adjustment initially provided was not quite enough to give the radius desired. Once the blanks were aligned, it was quite simple, if rather slow, to cut out the slots. The radius of the top edge was cut at the same setting. A good finish was obtained needing only light draw filing with a fine file to be ready for use. This finish is much better than I have seen obtained by the more common methods using end mills or slot drills. Considering that the material used is gauge plate, I think this was an excellent result.

As mentioned, for a proper job I would suggest that the hinge should be arranged to be in the middle of the shaper table. This will place the most accurate part of the curve right in the middle of the shaper. I arranged the job as nearly over the hinge as I could, but this meant some overhang and was also running into the limits of travel of the machine. Low friction bearings would be desirable, especially for the follower on the guide bar. Perhaps a pair of small ball races could be arranged to fit here.

Figure 3



© **A sketch of one of the tools used to machine the internal surfaces of the expansion link.**

Figure 4

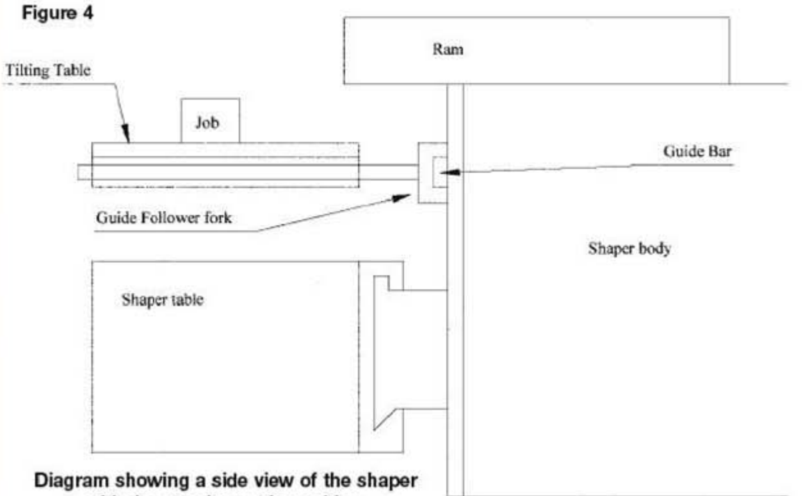


Diagram showing a side view of the shaper with the attachment in position. ©

LETTERS TO A GRANDSON

M. J. H. Ellis

discusses some of the hazards of steam car experimentation before deliberating on carbide lathe tools.

●*Part LXXVI continued from page 458 (M.E. 4245, 15 April 2005)*

Dear Adrian, I had a friend, now, alas long departed, to whom I used to refer affectionately behind his back as 'the Demon'. He was the most good-hearted of fellows, and his great passion in life was the steam-car which he was building from scratch. He was continually making alterations to it, but now and again he would hold a 'steam-up' to try them out, And truth to tell, in the oily overalls, which I doubt whether he ever took off, his face covered with smuts, and surrounded by a cloud of steam, it was not difficult to imagine that he was driving, it out of the mouth of Hell, rather than the ramshackle shed which served as its garage. I also remember him for the saying which he was fond of repeating: *"Engineers are the salt of the earth"*. I have no hesitation in saying *"Amen"* to that.

I was reminded of this worthy gentleman when I noticed on the shelf above the lathe a lathe-tool which I had made in accordance with one of his suggestions. This was, that in case of necessity, a serviceable tool can be made from the outer race of a worn-out ball or roller-bearing. I don't know what the composition of the steel is, but it is of very good quality for the purpose, and admits of being softened, hardened, and tempered in the same way as if it were an ordinary tool-steel. You could let the whole bearing down in the domestic fire by getting it red-hot and leaving it over-night, but my recollection is that I ground through the outer ring, and there was then enough spring in it to allow the inner parts to be driven out by brute force. Of course, when the steel has been got red-hot and flattened out, it will be narrow compared with its depth, so that it most likely will not fit into my favourite type of tool-holder (at least, without a lot of forging); but it can be held down in the old-fashioned way, and will be a good deal better than no tool at all.

This allusion to lathe-tools reminds me that I have never had much to say on the subject of carbide-tipped tools, and they are so useful that it will be a good idea for me to say a few words on the subject.

My researches suggest that the origin of carbide tips can be traced right back to 1859-61, when Robert Mushet obtained around 20 patents for alloys of iron and steel with chromium, tungsten, and titanium. Like his father before him, Mushet was an iron-master, whose works were near Coleford in the Forest of Dean. This is an area of natural beauty, bounded by the Severn to the east and the river Wye to the west, and it combines the attractions of the forest with the interest of industrial archaeology. I once visited the site of the Mushet works with an industrial archaeological party, and I am

Mr. Wilf Dyer tries out his Steam car. The chassis was from a 'Gwynn 8'.

sorry to tell you it is now completely in ruins, to the point where it requires a great effort of the imagination to picture the activity which once went on there.

Around 1870 Mushet went on to invent what was called a 'special steel', containing approximately 8% of tungsten. The alloy was much superior to ordinary cast tool-steel, and it can fairly be regarded as the progenitor of the 'high-speed' steels which came later, and in all of which tungsten is the most important ingredient, (around 15%). Steels of this type came into use around the turn of the century. The metals chromium, molybdenum, and tungsten all belong to the same family of chemical elements, and have a similar effect when they are added to steel. A typical high speed steel might have the composition: carbon 0.6 to 0.7%, chromium 4%, tungsten 14 to 17%, and vanadium 1 to 1.5%. The effect of the vanadium is to increase the hardness of the cutting edge.

It was discovered that the high-temperature hardness of high-speed steels was due to the presence of carbides, in particular, those of tungsten and its relatives. I cannot tell you who made this discovery, nor who conceived the idea that it might be possible to go one better by using carbide alone to form the cutting edge of a tool. However, carbide-tipped tools started to appear in 1926. A few years later, titanium carbide also became available.

With tips composed of these materials cutting speeds three or four times faster than those possible with HSS tools can be achieved, and the tool can go up to ten times longer before it needs to be re-sharpened. Tungsten carbide is the most suitable for use on non-ductile material, (e.g., cast iron); while for ductile material such as steel a mixture of tungsten and titanium carbides has been found preferable. It is recommended that carbide-tipped tools be given the keenest possible edge, and for this purpose, I use a diamond lap. I think I have mentioned previously that ordinary grinding wheels are no use for sharpening carbide tools, which require a special 'green-grit' wheel.

Molybdenum carbide is a cheaper, but no less effective, substitute for tungsten carbide, and I believe that it was used extensively during the war, when tungsten was in short supply.

To round the subject off, you may like to have a brief account of how carbide tips are made. The melting points of these compounds are so high that processes employing fusion are not used (tungsten carbide melts at about 2,500deg. C.). The carbide is first produced by sintering together a mixture of powdered tungsten and carbon (in the form of lampblack) in a hydrogen atmosphere, at a temperature of about 1,600deg. Celsius. The resulting carbide is then crushed to a powder. This is now mixed with 3 to 20% of powdered metallic cobalt and sufficient water to form a paste, which is then compressed to the required shape. The tips are then again sintered in a non-oxidising atmosphere (such as hydrogen) for about an hour at a temperature at around 1,500deg. Celsius. It may be stating the obvious, but the reasons for using carbide only for the cutting tip of a tool are:

1: on the grounds of expense, and

2: because the carbide, although hard, is also very brittle, and therefore needs close support.

What follows is only speculation on my part, but it seems to me that there could well be a connection between the hardness of the carbides and that of the diamond, the densest of the three allotropes of carbon. The hardness of diamond is attributed, and no doubt with good reason, to its closely-knit and rigid crystal structure. Could the carbides have a similar crystalline form? I think that I have probably said enough, as I learnt my chemistry 65 years ago, and it could be that the whole thing has since been unravelled.

As regards carbide-tipped drills, my experience has been, that if you follow the makers' instructions, i.e., keep them well loaded, and run them fairly slowly, they will fulfil the makers' promises. Of course, if the material you want to drill is so hard that a carbide-tipped drill is needed, you probably won't be able to make a centre-pop for the drill to start from. There may be instances in which it is possible to drill the hole first, and then make the rest of the work-piece to suit it, but otherwise, I can think of no better way of starting the drill in the right place than making a jig from sheet-metal.

Finally, carbide tips can be bought so cheaply at the stalls in model engineering exhibitions, and tools are so easy to make (the tips are no trouble to braze or silver-solder in place) that I always make my own.

I have a tip for you, and that will most likely be sufficient for the present letter. The model engineer often needs to make a three-way pipe joint, as, for example, where an axle-driven feed-water pump (in German, I expect that would be all one word) works continuously, but a cock allows the water to flow back to the tank. There is no call for union-nuts, and a T-junction is fiddling to make. So I use the type shown in my sketch (**fig 1**), which is just as good, and less trouble.

Your affectionate Grandpa.

●*To be continued.*

Fig 1 - Three-way union for $^1/_4$in. dia. pipe

©

Mr. Li, the author and Madame Li find time to sit and chat during the author's hectic visit to China.

Mr. Xu (white coat), Mr. Liang (ear protectors) and the author (black hat) discuss a SY 2-8-2 with a worker (with shovel) at the factory in Hohhot.

STEAM LOCOMOTIVES IN CHINA

Rhys Owen
escapes Christmas to enjoy the steam preservation scene in China.

One way of avoiding Christmas is to escape to China and stay in a flat in Shanghai whose staircase is guarded by a mynah bird which speaks Shanghai dialect. Follow this on Boxing Day with a bus ride through Shanghai's fearsome traffic to Shanghai West Station and train K258, which after a change to an odd number and a reversal at Beijing South Station traverses innumerable tunnels on its way to Inner Mongolia.

This was my first visit to China since 1999 and it was notable for the fact that steam no longer seems to play any part in the operations of China Railway, the national railway system, although a couple of SY 2-8-2 locomotives could be observed in industrial service at Xuanhua between Beijing and Datong. Long trains of coal passed by hauled by paired 8K class electric locomotives, built by Alsthom, and our passenger train was hauled by a Diesel locomotive.

After nearly 30 hours on the train I arrived punctually at Hohhot station and met once again my old friend (since 1984) Mr. Li Sen, also Mr. Geng Fenglin who helped me in 1999 and a new face. This was Mr. Liang Qinghai who, as a concession to a temperature of under -20deg. Celsius, was wearing a knitted garment which covered both his ears and his chin but no hat!

Mr. Li and myself had been planning this visit by e-mail but I was told that my initial idea of visiting the steam locomotives working on a coal railway at Zhunge'er, some two hours from Hohhot, had been vetoed by the railway motor pool on account of a recent fall of snow.

The next day I met the other members of the Veteran Scientist and Technician's Association of Hohhot Railway Bureau, of which Mr. Li is the President, together with representatives from the Ji-Tong Railway which, as is well-known hauls a large amount of freight behind QJ 2-10-2 steam locomotives. I learned to my dismay that the Railway Ministry is trying to force the JTR to 'Dieselise' and that, unless the Ministry relents, steam operations are thought likely to finish within three years or so.

One of the veterans was Mr. Ye Jian, a civil engineer and the Vice President of the Association, who told me he had built three railway lines since retiring from China Railway. The Veterans' hospitality was lavish and I was not only given a handsome scroll painting with a special poem but also entertained to a banquet at a local restaurant. As a long-time observer of China's railways I am keen that action be taken to preserve steam locomotives and I found that the Veterans are sympathetic to this and interested in knowing about preservation work in the UK and other parts of the world. A guide book to the Welshpool and Llanfair Light Railway and a description of that railway's operations was plainly of great interest.

Also among these veterans were Mr. Zhao Zhizong who had worked in quality control, Mr. Yang Zili who had been the Chief Engineer of the Jining Branch Bureau Locomotive Department, Mr. Xu Guanliang who had been a track maintenance engineer, Mr. Zhang Zongren who had worked in the locomotive operation department and Mr. Zhao Zhenying who had worked in the safety inspection department.

Mr. Li Sen, incidentally, was born in 1923 in Tianjin, studied at the Tianjin Anglo-Chinese College graduating from this institution in 1943. He later attended Beiyang University, graduating in Mechanical Engineering in 1948 (incidentally I was shown a picture of a young Mr. Li holding one end of a banner protesting against the Guomindang government). Following his graduation, and marriage to Madame Li Jingyan, Mr. Li began working in the Tianjin Railway Bureau, firstly as the leader of a wood cutting factory before being transferred to the Factory Department which controlled railway works in Tangshan, Tianjin, Shijiazhuang, Taiyuan and Beijing. In 1953 (four years after Liberation in 1949) Mr. Li was transferred to the Tianjin Railway Administration Bureau where he acted as the secretary of the Bureau Directory and became involved in the management of locomotive depots before being transferred to Hohhot in 1958 where he became the leader of the locomotive department. In 1962, owing to the vicissitudes of Chinese politics, because he was a *zhishifenzi* (literally a 'knowledge element' i.e. a graduate or intellectual) he was transferred to Baotou West Locomotive Depot to be trained as a worker in the Brake Shop, repairing air brake systems. He then served as the deputy leader of that locomotive depot for a year before being transferred in 1964 to Hohhot Locomotive Depot as the Deputy Director managing the maintenance and repair of locomotives for a year. He became Chief Engineer of the Locomotive Department of the Railway Administration in 1965. With the onset of the Great Proletarian Cultural Revolution he found himself working as a construction labourer (but with no reduction in salary although the education of his children was adversely affected) until 1973 when he was restored to his position and then became the Chief Engineer of Hohhot Railway Administration until his retirement in 1987. Madame Li graduated from Tianjin Catholic University in 1947 and she told me that she had studied one of Shakespeare's plays each term! Although one might argue against this educational method I can vouch for the fact that each of her English sentences was perfectly constructed.

The following day Messrs. Li, Liang and Xu took me to the Jiaohua factory where we examined a SY 2-8-2, which was occupied in shunting. Incidentally, it seems to be the habit in China to carefully warm the cylinders before moving off by keeping the brakes hard on, opening the cylinder drain cocks, gently opening the regulator and moving the reverser back and forth. This is apparently intended to minimise the amount of movement with open cylinder cocks and permit maximum traction when starting. Later we paid a visit to Hohhot Iron and Steel Works where a clean SY was stored, the air hoses between engine and tender carefully uncoupled to allow water to drain out. A plug had also been removed from the water connection between engine and tender for the same reason. We then visited the Hohhot Railway Bureau Drivers' School where we were warmly received by the Director, Mr. Guo Yimin and shown around by Mr. He Shuchun. First stop was the shed where firemen could be trained (apparently still used by Ji-Tong trainees). A number of imitation backheads were set up with firehole doors controlled by a foot-pedal and these could be used to practice shovelling coal to a prescribed pattern. The next stop was to examine a SL 4-6-

A locomotive (probably a QJ) blowing down its boiler at the summit of the line between Changchun and Mengjiatun.

A highly decorated RM (pride of a shed?) comes into Changchun with a train from the East.

2 which is located in the school grounds. This locomotive had been transferred to the School by Mr. Liang Qinghai during his reign as the Director of Hohhot Locomotive Depot. It transpired that this excellent gentleman had arranged this upon Dieselisation of the passenger turns because the locomotive was that upon which he had worked as a fireman! After a visit to the driving simulator where I had a go at 'driving' a DFH Diesel locomotive and to the School television studio we were entertained to lunch by Mr. He.

Mr. Liang Qinghai, incidentally, is from Henan province in central China. After three years at technical school he served for three years as a fireman then for six years as deputy driver (this post involves some firing, driving under supervision and other duties delegated by the driver). After a year as a driver he worked in the railway police office and as secretary of the Communist Party branch before spending eight years as the Director of the Locomotive Depot. A tall man with high cheek bones, he is a noted calligrapher.

The following day the four of us took a train to Baotou where we visited the Locomotive Depot, being received by the Director Mr. Yang Guilin and two gentlemen named Zhong and Yang. A television system allows Mr. Yang to monitor activities in the, very clean, Diesel repair workshops! We were shown some stored JS 2-8-2 locomotives (mainly 1988 built machines) and three QJ 2-10-2s together with three rarities, Soviet built 2-10-2 FD1653, an early (probably Japanese built) 2-8-2 JF518 and 2-10-0 DK114. Following a very pleasant lunch we set off for the station in a minibus. In his enthusiasm to get us to the station in time the driver managed to skid the vehicle through 360deg. and we only avoided falling down into the surrounding fields by about a metre! This vindicated the decision not to venture to Zhunge'er!

The following day we visited Hohhot Locomotive Depot where we were warmly welcomed by the Director Mr. An Zhijie, the Deputy Director Mr. Wang Limin, the head of the locomotive technical department Mr. Gao Minglu and Mr. Zhu Zhenguo the Director of the Wheel Workshop. Mr. An incidentally had a model of JF class 'Mao Zedong Hao' in his office. We were shown around the Locomotive Repair Machine Shop where Mr. Li was enthusiastically greeted by a veteran worker (it is a mark of Mr. Li's excellence as a manager that wherever he goes old subordinates are always happy to greet him) who was turning a bearing on a lathe. QJ7162 of Baiqi depot of the Ji-Tong Railway was undergoing '*Jianxiu*' (inspection & repair) and I was shown the machine the Depot had built to polish the ends of the superheater pipes to ensure a good connection. I was also shown the rig for air-testing the superheater fire tubes and the device for cleaning the outside of boiler tubes of scale. This consisted of a large box with two chains which were used to move a bundle of tubes so that they rubbed scale off each other (I am not sure what was done with these tubes afterwards). When, with Mr. Li's help, I asked whether optical alignment methods was used I was shown a pattern of five points near the horns of the axle box on the frame of the QJ, which could be used to check the alignment of the axle centre. A tolerance of 0.5mm was allowed in the horizontal direction. I assume that the vertical direction would not be so critical. I was also shown a machine, again made by the depot itself, which (I think) could be used to face up all the white-metalled surfaces of an axle-box in a single set-up. The wheel shop contained equipment for removing locomotive tyres and included a vertical lathe made in Qiqihar which was large enough to machine the tyres of the SL and RM pacific classes. One of QJ7162's piston heads was being turned on a large lathe, presumably to clean up the grooves for the piston rings. After examining an electric machine designed by the Veterans' Association for pulling tenders away from locomotives and various jigs and other devices we were shown the Locomotive Crew Signing-on Point where the Regulations could be read at the touch of a computer screen. We also paid a brief visit to the Statistics Department, noting a solitary QJ and at least one steam crane parked on a siding, before departing to a restaurant where Mr. Wang hosted a most convivial banquet.

The following day after being entertained further by Mr. Li, Madame Li and their family I departed for Beijing in the company of Mr. Liang and Mr. Xu. During the journey the discussion, although hampered by the limitations of my Mandarin, veered over a number of subjects and, using a diagram Mr. Liang managed to ask me whether I had come across displacement lubricators in Britain. I managed to explain that they were not common although I had heard of them (a displacement lubricator is an oil reservoir connected to a steam pipe or cylinder by a small tube which protrudes upwards into the reservoir. The reservoir is filled with oil and closed. As steam enters into the reservoir via the small tube it condenses into water which displaces oil above the upper end of the tube and hence down the tube into whatever requires lubrication. There may be a constrictor in the tube and there is almost certainly a means of draining the water before the reservoir is refilled).

After our arrival in Beijing, thanks to the influence of the Veterans' Association, we had a private viewing of the recently opened Locomotive and Car Exhibition Hall of China Railway Museum, being shown around by the Curator, Mr. Teng Jiuxin. The address of this exhibition hall is North of Loop Line, No. 1 Jiuxianqiao North Road, Chaoyang District, Beijing (tel: 010 5184 1314/1374; fax: 010 5184 5304). The Loop Line is in fact a circular test track used for testing locomotives. The No.403 bus from opposite Beijing Main Railway Station terminates near to the exhibition hall, which is a very pleasant purpose built hall housing a collection of locomotives and models. The locomotives present have been prepared for exhibition by Nankou Locomotive Depot and they have done a splendid job.

The exhibits include one of the first locomotives used in China, and the oldest still in existence, number '0', a tiny 0-4-0 saddle tank locomotive whose builder Mr. Teng wishes to identify (the shape of the smokebox door hinges leads me to surmise that it was built by Dübs but I would be grateful if anyone who knows the truth would let me know). This locomotive is fitted only with a front coupling for propelling the Imperial coach. In the cab a tall column above the firebox combined the functions of dome and steam fountain. No injectors appeared to be fitted but a single axle-driven pump supplied water to the boiler (although there appeared to be no visible clack valve at the entry to the boiler). No cylinder drain cocks were fitted either, condensate being presumably dissipated via the slide valves which were between the plate frames and therefore presumably with vertical faces. To gain access to the smokebox door a door in the front buffer beam (apparently a later addition) had to be opened first.

Other steam locomotives present included two JF class 2-8-2 locomotives which were, unusually for China, named. *Mao Zedong Hao* was fitted with a false skyline casing making it look like a JS class, as well as large smoke deflectors and a tank in the tender for auxiliary oil firing. Mr. Liang explained that, although there was a mark on the water gauge (connected on the drivers side to a reservoir whose purpose is to damp out short-term fluctuations in the level), it was in fact possible to run the water

A QT locomotive with an interesting breakdown crane forming part of its train.

An SL Pacific hauling a secondary passenger train. This and the other action photos were taken in 1984 when steam traction was still common in China.

level down still further so long as water continued to come out of the drain at the bottom. This observation could be confirmed by examination of the position of the gauge relative to the holes for accessing the crown sheet when washing out the boiler.

On Chinese locomotives the washout holes are covered by dished plates whose internal threads mate with external threads on the apertures. I asked whether the barrel was washed out via a plug in the smokebox tube-plate and was shown a number of the above-mentioned washout holes covered by dished plates on the underside of the boiler barrel of one of the locomotives. Washout holes for accessing the arch tubes were also evident.

The other JF was *Zhu De Hao* (Marshal Zhu De was one of Mao Zedong's generals) and was again fitted with a false skyline casing. Mr. Liang pointed out that the arrangement for preventing a build up of vacuum in the cylinders when drifting had been modified - language problems meant that I could not understand how but these locomotives appear originally to have been fitted with a by-pass arrangement. Other treasures included a GJ 0-6-0T, an early QJ 2-10-2, an JF6 light 2-8-2, a SL6 4-6-2 (the standard SL) the first RM 4-6-2 and a SL12 4-6-2 (whose boiler lagging at least was tapered although I could not confirm whether the barrel itself was). Interestingly, a number of the works plates on these locomotives featured the old 'Bopofomo' transcription system for Mandarin, probably giving the original Chinese approximation for the name used for the wheel-arrangement (e.g. Mi Ka for 'Mikado'). With the possible exception of the SL12 which was built either in Japan or at a Japanese-run works in China all the foregoing locomotives were constructed in China and after liberation in 1949. In addition to these there were a number of Chinese-built Diesel and electric locomotives, including the first SS electric, first DFH Diesel shunter, first DF and BJ mainline Diesels and a number of coaches.

Steam locomotives definitely built outside China included a Belgian (Tubize?) 2-6-2 tender locomotive, a KF 4-8-4 built by Vulcan to a design prepared in China (a sister loco is in York Railway Museum) and a KD7 locomotive supplied by the United Nations in 1947 (built in America by Baldwin). This last class, similar to the KD6 class known in the UK as the S160 class, can be distinguished by the gap between the last two driving axles and I remember seeing examples of the class active in Shanghai in 1984. This loco was right-hand drive (Chinese locomotives are normally left-hand drive).

On one of the locomotives Mr. Liang pointed out a displacement lubricator on the steam pipe leading to the motor for driving the stoker feed screw, saying that he understood the device to have been introduced from the Soviet Union.

All too soon we had to leave for our final destination, Mr. Xu Guangliang pointing out some of the sights he remembered as a boy. A native of Hebei province (which surrounds Beijing) he came to Beijing at about seven years old when his father, a track maintenance specialist, was transferred to the city. After completing a college course Mr. Xu followed in his father's footsteps and became a track maintenance engineer, later becoming the leader of a railway finance department.

Our final call was at the China Railway Publishing House at 8 You'anmen West Street, Xuanwu District, Beijing 100054. The most interesting find (and purchase!) was *Zhengqi Jiche Chengwuyuan* (Steam Locomotive Crew Member). This is a 700 page volume packed with information for anyone involved with Chinese locomotives ranging from main dimensions of various classes, what appear to be the firing patterns for various types of locomotive, explanations of the use of various tools including the principle of the Vernier scale, various thermodynamic calculations and a host of other matters which confirm my previous judgement that Chinese enginemen are highly trained. Unfortunately the effort it takes me to read Chinese means that I shall probably never read much of this book but in the introduction I did notice Mr. Li Sen's name as one of the contributors to the first edition.

After a final meal I bade my new friends farewell. In my mind's eye I can see them both now, Mr. Xu smiling as he remembered a childhood within the walls of old Beijing, Mr. Liang striding majestically along the road treating the traffic swirling around him with lordly disdain.

The only incident of note during the next two days was a conversation with a Korean gentleman who was pleased to try out his English on me. I was momentarily flummoxed when he said *"Wipe Jap"* until I remembered that Koreans have difficulty in pronouncing 'f" and deduced that his wife was Japanese.

A final word on Chinese road traffic conditions - a few days later in an industrial area of Shanghai I had just crossed the road when I heard an impact behind me and turned to see a tiny minibus somersaulting in the air before landing on its side. Petrol poured from its tank and its three occupants climbed out to remonstrate with the driver of the car which had just collided with them.

All in all a most interesting and enjoyable visit during which I was very graciously entertained and learned something of the life histories of some people who had lived through several decades of tumult (I well remember Madame Li saying simply but firmly *"I hate the Japanese"* after describing the bayoneting of Chinese children by Japanese soldiers).

I was also encouraged to see that Chinese railway personnel and China Railway are increasingly aware of the importance of their industrial heritage and are keen to see locomotives and other railway artifacts preserved. I am keen to see the preservation of some steam locomotives in working order and am particularly encouraged to read on the internet of a Mr. Fan Yongjun, who runs a railway locomotive technology research centre in Wafangdian near Dalian in Liaoning province. It seems that Mr. Fan has bought three locomotives (a GJ 0-6-0T, a YJ 2-6-2 tender locomotive and a 762mm gauge 0-8-0) and is actively restoring them as shown by the before and after pictures, the latter showing the GJ in steam. The article also stated that he was building a 1:12 scale working model locomotive so perhaps *Model Engineer* may soon have another subscriber! Finally, for those further interested in Chinese locomotives, the following books will be of interest.

1: *A Picture Album of Steam Locomotives in China 1876-2001*. Published by China Railway Publishing House, ISBN 7-113-04148-5. This has many pictures with captions in Chinese and English but is not very technical.

2: *A Survey of Steam Locomotives*. Published by China Railway Publishing House, ISBN 7-113-03164-1. Much, if not all of this, appears to have been written by staff from Datong Locomotive Works and the text is both in Chinese and English. This has fewer pictures than (1) above but is much more technical.

3: *Jiche bolan* (*Panorama of Locomotives 1881-1991*). Published by Beijing Railway Bureau, but with no visible ISBN number. This book shows pictures of locomotives used in the Beijing Railway Bureau area and gives details of where they came from and what happened to them. The information is sometimes open to question and some details are not supplied presumably because they were not available to the authors.

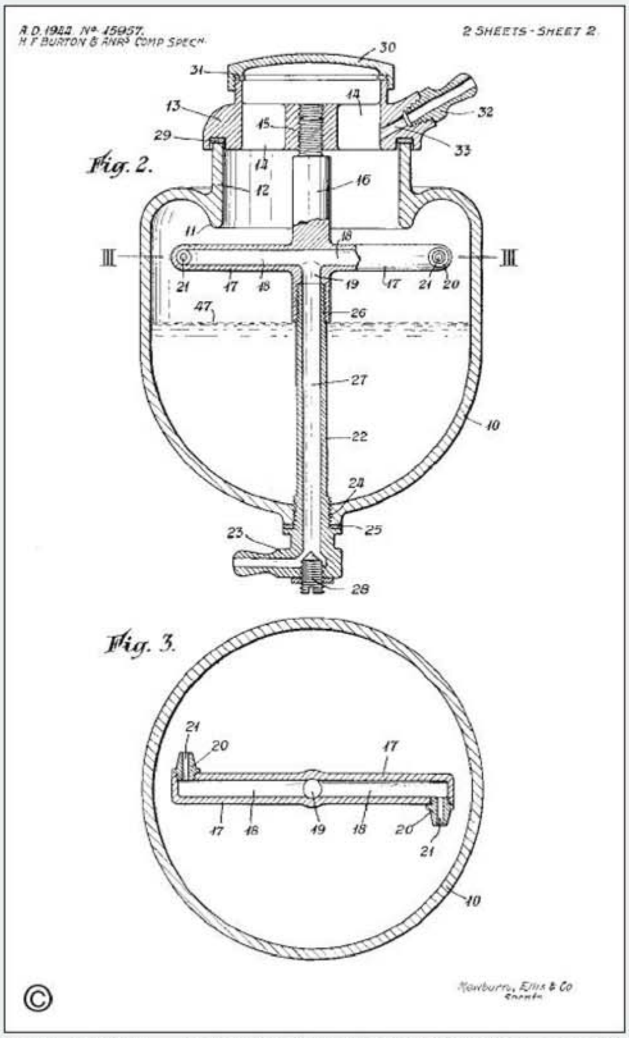
MOISTENED FUEL AND AIR AND THE INTERNAL COMBUSTION ENGINE

Dr. Malcolm J. Metcalfe describes an invention devised by two of his forebears.

I seem to remember correspondence appearing in *Model Engineer* on a number of occasions over the years regarding the possible advantages of humidifying the inlet charge to an internal combustion engine. I therefore thought that readers would be interested in a description of an early device devised for this purpose. This was patented by my grandfather and granduncle, Henry Farrow Burton and Henry Stanley Jackson on 21 August 1945, patent no. 593,030.

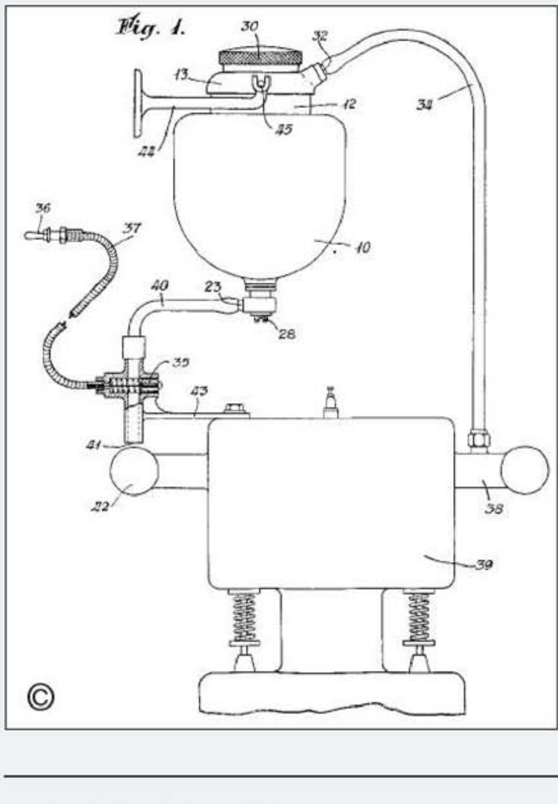
During the early war years they had become intrigued by the observation that many internal combustion engines appeared to run rather better in wet as opposed to dry weather. Following several experiments using an early Morris, they finally filed a patent application entitled 'Means for supplying a supplementary charge of moistened fuel and air to an internal combustion engine'. The accompanying copies of the original drawings are relatively self-explanatory. The basic principle was to draw hot air from around the exhaust manifold and to swirl this air around a water chamber (thus increasing its humidity) before allowing it to be drawn into the inlet manifold. It was claimed that this device would significantly improve the economy of the engine by increasing the obtained power in relation to the quantity of fuel used. Once the device had been attached to the engine, it was set up by adjusting screw 28 until the engine just started to run erratically. The device could be switched off, when desired, at the dashboard by operating the Bowden cable controlled gate 35.

Unfortunately, there are no remaining records available to substantiate the claim of improved economy and only a few parts remain in our possession, insufficient to make up a complete device. Originally, the water container was made of glass (approximately 3in. diameter) but after a short time in production this was altered to a spun aluminium alloy container. Several of these devices were sold around the north east of England over a five-year period before expiry of the patent, which was not renewed. It is known that the device was not a commercial success, small improvements in economy would have been given a low priority in the immediate post war period.



Is there any evidence that such devices actually worked? In my own view, it was most probably a 'hit or miss' affair, as carburation of engines of this period was certainly not an exact science. I suspect that if the device had a favourable effect in optimising the inlet-charge mixture, a benefit may have been found. I remain, personally, sceptical that mere humidification of the inlet charge would lead to significant improvements in economy, particularly in modern engines. Water injection in turbo-charged engines may be a different matter, as the volume of gas passing over the turbo-charger will be increased.

I should be particularly interested to examine a complete device if any reader has one in his or her possession. It would certainly make an unusual and realistic accessory for a miniature period internal combustion engine.



(The use of water with the fuel/ air mixture fed to internal combustion engines has been tried a number of times over the years to improve economy and the running characteristics of these engines. It was certainly tested at Brooklands in the 1920s to help prevent pre-ignition in air cooled engines. Two-stroke engines especially seem to run better when there is some moisture in the atmosphere and a well-known dodge used by scooter rallists riding Vespas in the 1960s was to place a rag well soaked in water in the little cupboard housing the carburettor.

Your Technical Editor's 1922 Raleigh runs more cleanly and will accept more ignition advance during wet weather although the extra power that may be produced is rather academic as any attempt to use it will usually result in chronic belt slip which is an ever present problem on belt driven machines in wet conditions. If any readers have experience of the use of water with fuel or have knowledge of the above device we would be glad to hear from them - Ed.)

The completed spring hammer complete with miniature operator.

A MODEL POWER DRIVEN SPRING HAMMER

The late **Dave Lammas** introduces an attractive little model of a machine, once an important fixture in the mechanised forge.
●*Part I*

So what, you may be asking, is a spring hammer? Those who have studied the blacksmith's history in some detail will be aware that the industrial revolution created the need for a massive increase in forged metalwork beyond the scope of mere muscle power alone. Readers may remember an earlier model operated by foot-power, described in *Model Engineer* (series starts *M.E.* 3884, 2 November 1990), which was an *Oliver* hammer. The present model represents the next stage of development in which water or steam power drove a belt coupled to the hammer mechanism in order to increase both the hammer impact and the rate of striking.

It will be readily understood that the hammer could not be directly fixed to the crosshead of the machine since that would impose unacceptable stresses on the working parts. By interposing a strong 'cart spring' between crosshead and hammer the necessary elasticity of blow was preserved as well as making use of the energy stored by the spring during stroke reversal.

The speed of rotation of the crank, the strength of the spring and the mass of the hammer constitute elements of a 'tuned system' such that either or all of these may be varied to provide the desired rate and intensity of impact. In practice the hammer weighed about 50lb and the crank revolved at between 150 and 300 revolutions per minute. That gives about $2^1/2$ to 5 blows per second. Just imagine trying to swing a 50lb sledge hammer that fast and you should get a very good idea of the potential increase in production.

The hot metal was still manipulated under the hammer by means of tongs held by the blacksmith. Therefore his skill in handling determined the quality of the finished forging. By attaching heads of various shapes to hammer and anvil, different types of work could be undertaken as with the *Oliver*. The spring hammer was used in factories for the mass production of small forgings rather than by the traditional village blacksmith who tended to make single items for repair purposes at this stage although often some complete items were made.

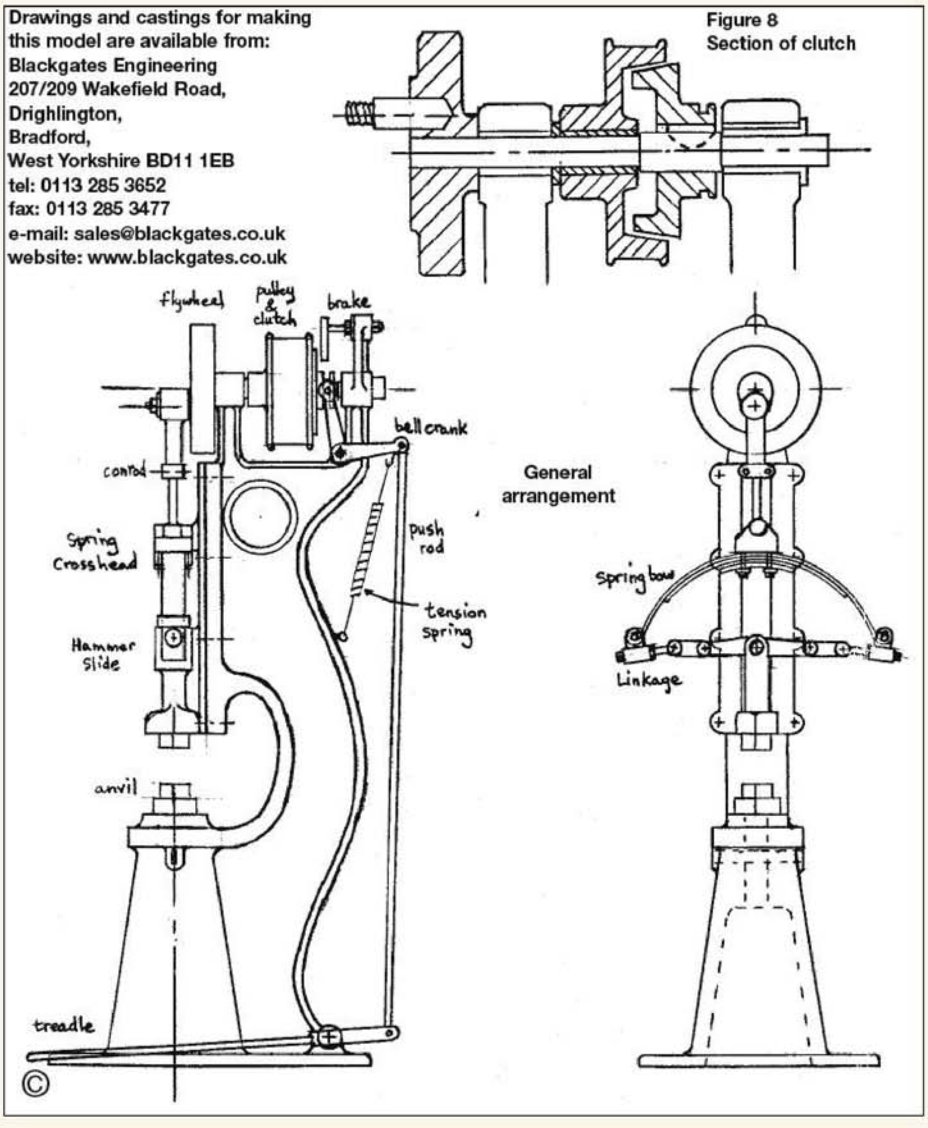
Description

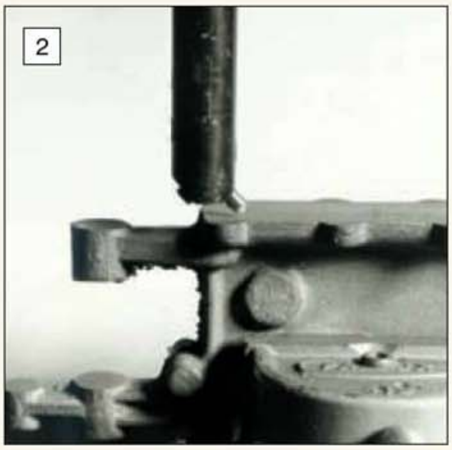
As can be seen from the general arrangement drawing, the machine consists of a substantial iron casting the lower part of which constitutes the anvil. Above this is a vertical guide wherein the hammer and crosshead slide in alignment with the anvil. At the top of the casting is a pair of horizontal bearings carrying the crankshaft and driving pulley within which is a sliding clutch member held in engagement by foot pressure on a treadle bar surrounding the base. A tension spring is fitted to release the clutch as the foot is lifted.

A connecting rod adjustable for length connects crank and crosshead. The 'cart-spring' is firmly bolted to the crosshead at its centre while the spring eyes engage a set of jointed links on either side of the hammer to allow for flexible movement. At rest the hammer does not touch the anvil even when the crank is at bottom dead centre. As it reciprocates faster and faster so the flexed spring throws the hammer lower and lower until it contacts the work piece resting on the anvil. Some variation of blow to suit the work in hand can be arranged merely by lengthening or shortening the connecting rod as necessary.

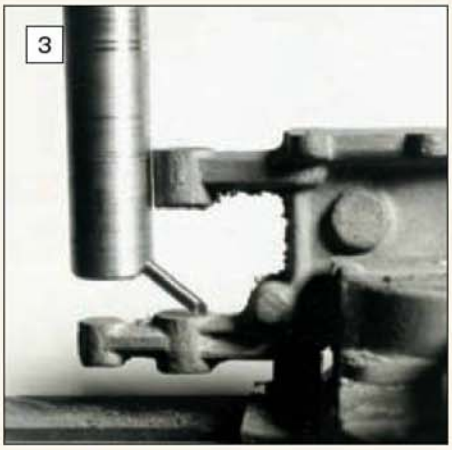
It will be seen that the anvil and hammerhead are set at 45deg. to the axis of the casting so that the operator may stand to one side or the other

Drawings and castings for making this model are available from:
Blackgates Engineering
207/209 Wakefield Road,
Drighlington,
Bradford,
West Yorkshire BD11 1EB
tel: 0113 285 3652
fax: 0113 285 3477
e-mail: sales@blackgates.co.uk
website: www.blackgates.co.uk

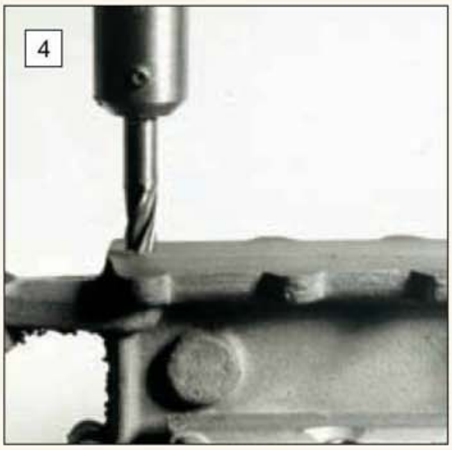




Fly-cutting the slide surface of the main casting on the milling machine.



Fly-cutting the rear bearing boss using an extended fly-cutting tool.

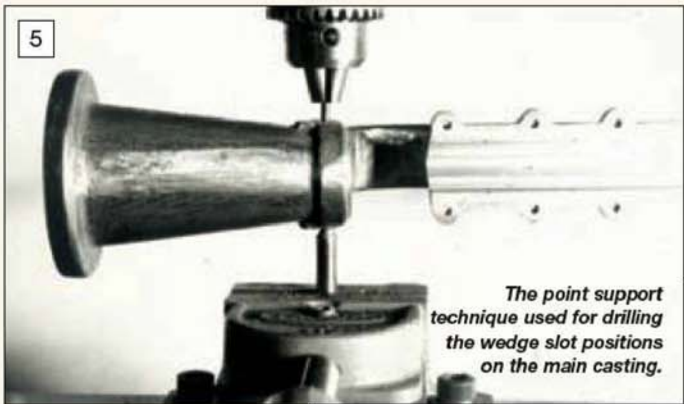


Milling the slide groove. A slot drill would have been a better tool for the initial slot.

enabling long bars to be forged without fouling the machine. I suspect present day safety inspectors would be horrified to see workmen in such close proximity to unguarded machine parts thrashing about in that manner.

Construction

Commence by cleaning up the body casting with old files. Note that the rear portion of the base



The point support technique used for drilling the wedge slot positions on the main casting.

should remain clear of the ground but get the base itself reasonably level so that it stands without rocking about. It is not really necessary to machine this part, thanks to my accurate pattern making, but do so if you prefer (**fig 1** shows this component).

Clamp the casting by its base to an angle plate on the lathe cross-slide, or to the milling machine table, to fly-cut the anvil face using a long fly-cutter spindle held in lathe chuck or in the milling machine mandrel. The anvil face must be parallel to the base.

Next hold the casting in the machine vice on the vertical slide or on the milling machine gripping it by the rear curving flange which forms a secure mounting (**photo 2**). Set the casting slide-face parallel to the direction of travel either by checking the base is at right angles to the table using the try square or by traversing the work past a pointer held in the chuck. It must be level both longitudinally and 'athwartships'. Fly-cut the slide face at this setting then go on to fly-cut the bearing bosses for the crankshaft without disturbing the casting. Just face the upper side of both front and rear boss (**photo 3**). Change to a centre drill, pick up the centre of the front boss and drill. Open out with a stiff drill, at least 1/4in. dia., and go straight on through the rear boss as well. Open out further to reaming diameter for a 3/8in. reamer and ream. These bores should now be in line and also at right angles to the slide. Again without disturbing the set-up mill the slide groove to 1/8in. deep by 3/4in. wide keeping it central in the casting (**photo 4**). Relieve the middle portion of the groove to 1/32in. depth by 3/8in. wide to minimise the sliding contact.

Leave it set up to drill and tap the eight lugs 4BA by which the slide covers are attached with studs and nuts. Go on to use an end mill to machine the wedge slot bosses on either side of the anvil.

The upper transverse bosses for the clutch bell crank pivot and also the base bosses for the treadle pivot can be end milled if the casting is clamped by the slide face to the machine table. Using a scribing block or height gauge mark out the latter four bosses and centre-pop deeply. These holes can be drilled making use of the 'point support' technique on the drilling machine as shown in **photo 5**. Alternatively they can be drilled in the lathe or milling machine after clamping in accurate alignment.

●*To be continued.*

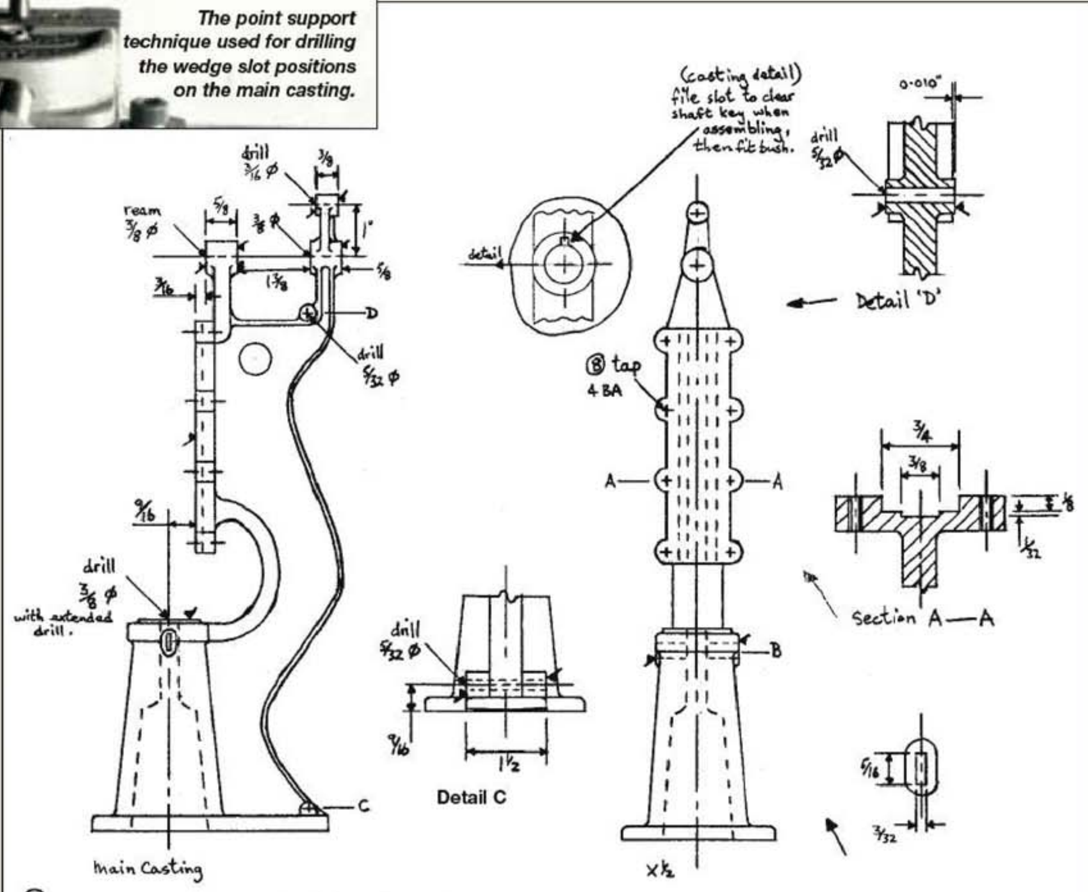


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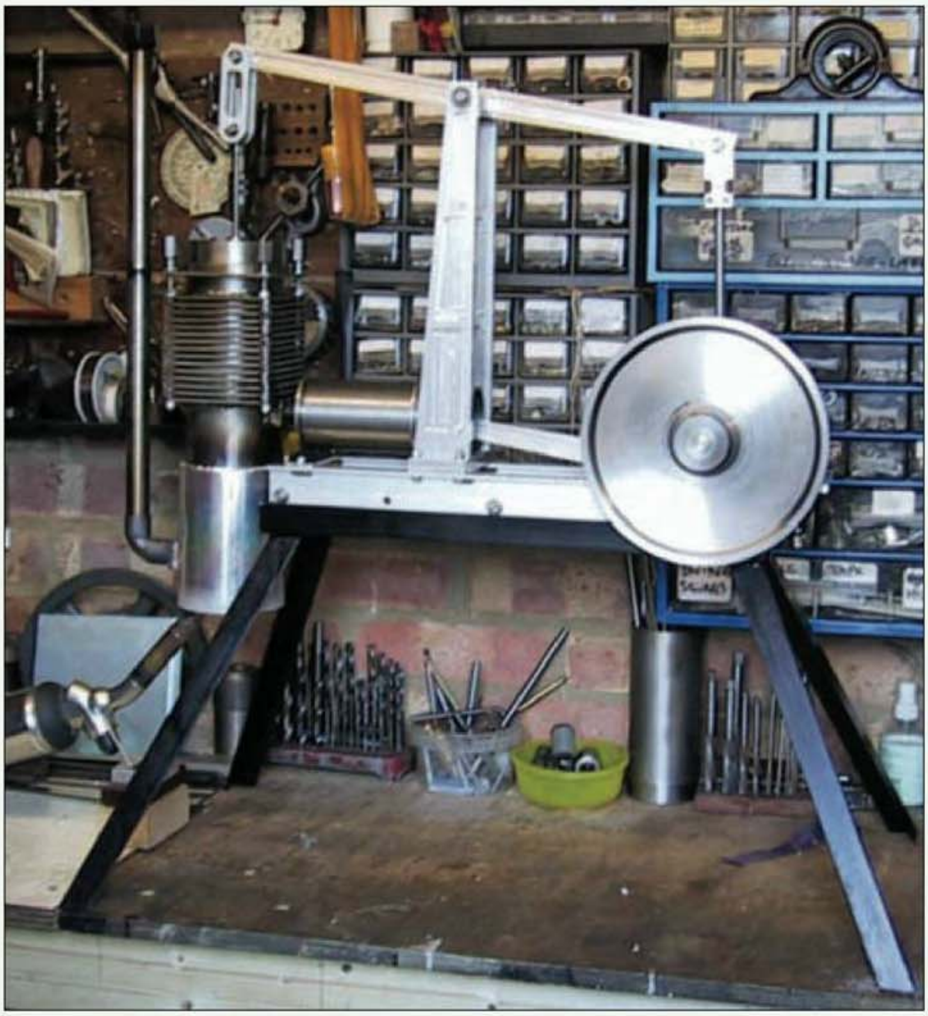
Fig 1 Both views and details of A,B,C, D



The impressive hot air engine designed and built by the author

HOT AIR ENGINE

J. Wilson
describes a hot air engine that is larger and more powerful than the norm.

Hot air engines and their history have always fascinated me and, after building a small freelance engine and then a scale Robinson engine, I decided to build another freelance model, only this time a lot larger and totally to my own design. I like to use as much scrap material as I can, thereby cutting down on cost, but found in my new venture that I had to buy quite a lot of bits and pieces because of the physical size of the engine.

I had originally planned on a 3in. displacer and $2\frac{1}{2}$in. power cylinder, with a 3in. stroke on both pistons, but I hit problems finding any $2\frac{1}{2}$in. heavy wall tube for the power cylinder and ended up using a billet of $2\frac{1}{2}$in. O/D free cutting steel which of course had to be bored, so I finally settled for a $2\frac{5}{32}$in. bore (a very wasteful way of doing it).

I used some H-section aluminium alloy (from office partitioning) as the base and built the components up on this. The first flywheel was turned out of a piece of 6in. dia. by 1in. thick mild steel (though I had intended to use a 12in. flywheel, I could not find any suitable material). This has proved too light to give smooth running, so I have added a 8in. flywheel (made from an old V-pulley that I had laying around in the workshop) and that has made the engine run more smoothly, though I still hope to make a 12in. flywheel one day.

The displacer piston was made from the centres of two of the cooling fins after they had been trepanned out and the wall of the piston was made from some copper coated tin plate scrounged from a bankrupt buckle making company. The power piston was made from a billet of cast iron, which I had to purchase, along with the aluminium alloy to make the A-frames and beam. The moths had a terrible shock when I prized open the wallet!

The mild steel angle that the whole thing stands on, was purchased from B&Q, who I have just found out are a good source of mild steel flat, angle, square and metric thread studding as well as quite a good range of machine screws and nuts. As can be seen from the photos, the A-frame and beam were milled to give the appearance of castings.

The power cylinder is connected to the displacer cylinder at the mid stroke point, by a standard $\frac{1}{4}$in. BSP barrel nipple. The end cap of the displacer cylinder is $2\frac{1}{2}$in. inside the bore of the cylinder, forming a firebox.

All the bearings are brass, pressed into their respective locations. The pins are silver steel with the small end being $\frac{1}{4}$in. O/D, the big end being $\frac{3}{8}$in. O/D, the flywheel shaft is $\frac{1}{2}$in. O/D, the main beam pivot is $\frac{3}{8}$in. O/D and all other pivots are $\frac{5}{16}$in. O/D.

The flywheel shaft plumber blocks, power piston connecting rod big end and beam to crank connecting rod big end are all split and bolted so that they can be removed easily as can be seen from the photos.

Detail view of the crankshaft and main bearings of the engine

The power cylinder, piston and connecting rod. Note the A-frame construction.

The cool end of the displacer cylinder showing the cooling fins.

Specification

Displacer Cylinder: 9 1/2in. long by nominal 3in. bore. Material, heavy gauge steam pipe.
Displacer Piston: 2 7/8in. O/D by 6in. long. Material, tin plate with 1/8in. end formers.
Power Cylinder: 2 5/32in. bore by 6in. long. Material 2 1/2in. O/D free cutting mild steel.
Power Piston: 2 5/32in. O/D by 2 1/2in. long. Material 65mm O/D cast iron billet.
Beam: 8 1/2in. centre from displacer to pivot and 8 5/8in. from pivot to crank pivot.
Overall length: 18in. Material 1in. by 3/8in. aluminium alloy flat.
Stroke on both cylinders: 3 inches.
Flywheel: 8in. Material cast iron pulley with V machined away. Original flywheel was 6in. O/D by 1in. wide free cutting mild steel.
Height of A-frames: 13in. from base. Material 2in. by 1/2in. aluminium alloy cut diagonally along its length to make two A-frames.
Cooling fins: 15 off 1/8in. mild steel plate by 4in. square, trepanned to fit displacer cylinder and tack welded on.


A view looking down on the engine showing some of the constructional details of the base. Firing is presently by gas torch.

Test run and modifications

The first time I tried to run the engine, after making sure that there were no tight spots or points of friction, I used a gas blow lamp as the heat source and, although I did finally get the engine running, it was extremely slow and jerky. It was obvious that (a) more heat was required and (b) the flywheel was to small, so as previously mentioned I made a larger flywheel. I also lagged the hot end and resurrected my dad's old paraffin blow lamp. These modifications to the engine have improved its running, power and speed no end, with a speed in excess of 180rpm timed with a stopwatch and counting the turns over 5 seconds, not very accurate but at least a pointer and I couldn't count fast enough to get above 5 seconds. Once up to speed the engine is very smooth running with no noticeable vibration.

However, the main change was to bore the displacer cylinder head and insert a short piece of turned steel tube 3 7/16in. O/D by 7/8in. deep by 1/8in. wall thickness. This allows me to fill the top of the cylinder head with water to help cool the cold end of the displacer cylinder and I would definitely water-cool the engine if I was to rebuild it. I increased the thickness of lagging around the hot end of the displacer cylinder and can now run using a standard gas torch, which is much more pleasant and easy to use than a paraffin blow lamp. Warm up time is about 3 to 4 minutes before the engine will start on a spin of the flywheel and then perhaps another 4 minutes to get up to full speed. Stopping is interesting as the engine runs on for about 3 minutes after removal of the gas torch and once the torch is turned off you realise how quietly the engine runs.

I have made a stand out of 1in. steel angle, the top of which forms a frame into which the engine sits so that I can lift it out for modification or transport without having to unbolt anything. I have also found that the smaller 6in. flywheel is unnecessary and I have dispensed with it (no doubt to be used in some future project).

Finally

I have been asked if I am going to paint the engine and the answer is emphatically no! I hate painting, so apart from one or two components that I have oil blacked, it will remain as is. One thing I did not allow for when starting this project, is just how big (27in. by 16in. footprint and 30in. tall) and heavy it would end up, so now I have a large engine and nowhere to put it! For those of you interested in photography, the photos were taken with a Canon S10 digital camera taken with 2.1 Mega pixels and processed on a Advent laptop computer.


A view of the displacer cylinder with the engine running.


The flywheel is at present an old pulley and could be heavier.


The robust beam to displacer rod link made from aluminium alloy.

KEITH'S COLUMN

LILLIAN
A NARROW GAUGE LOCOMOTIVE
for 7¼in. gauge

Keith Wilson
owns up to some errors then goes on to describe the cylinders for this superb narrow gauge locomotive.
●*Part VIII continued from page 463 (M.E. 4245, 15 April 2005)*

Just to make a change, an annoying clanger has arisen on the frames/motion bracket positions. I am not sure how it happened, but the holes in the frame are wrongly positioned – my fault. Rear end duly held out for kicking. Ouch! The dimension of 2.25in. for hornblock cut-outs (cuts out?) is wrong; it should be 2.5 inch. The laser drawing is in fact correct in this respect. There will be more on this particular topic in a future issue.

These problems only came to light on collecting our sets of laser-cut frames. One of the holes didn't line up anyway, so I got onto the computer drawings and superimposed the bracket on the frame drawing, locating it precisely by the position of the centre of the expansion link pivot.

I doubt if anyone has started too much yet on this locomotive. But there is ample room for relocation of these holes. It will probably mean that a bit has to be removed from the bottom of the bracket to clear the brake lever hanger.

I suggest, in view of the possibility of misalignment of the holes in the bracket(s) – it is not too easy to get holes lined up so accurately as might be hoped for in such a case – that the bracket is lined up from the top of the frame and the middle wheel centre line by the centre of the pivot hole (¾in. diameter) and the easy-to-reach holes are spotted through. It is not a perfect way, but should produce reasonable results. However, a yet better method has just suggested itself and will be described next time.

Now that my present batch of locomotives has just finished, (pretty picture overleaf – modest blush) we are making fast progress with the next pair – two *Lillians*. One each, but both our locomotives will be slightly different from the main drawings, although I will give some alternative details in due course.

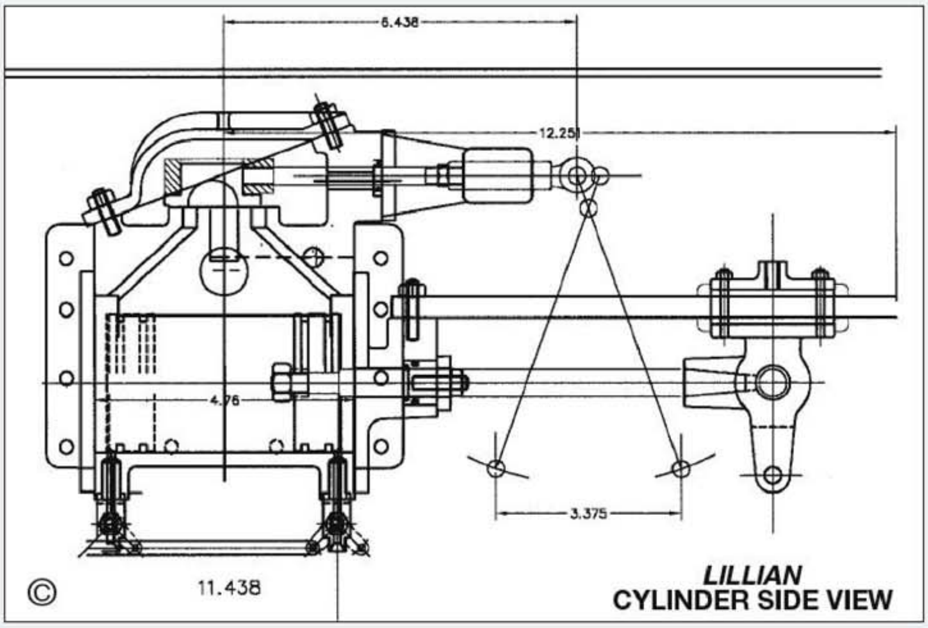
Incidentally, the name *Lillian* was chosen as a little tribute to dear old LBSC, for he was actually registered as female and named *Lillian*. Physically he was male, and the grapevine told me that there was quite a kerfuffle when he was carted into hospital on his last physical journey; for he demanded to be put into a women's ward. Regretfully (or otherwise!) the hospital staff refused to play, and I have often wondered what the legal position was! So the yarn went.

The main thing is that photographs will be available of parts made, and clangers (ugh) rectified – there are some, fortunately so far fairly minor.

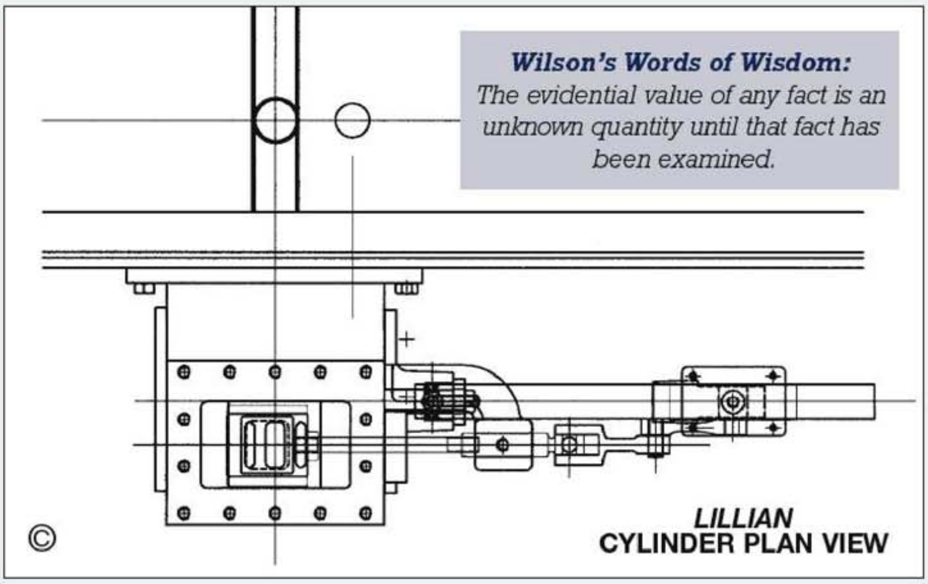
The drawings of the buffer plates need modifying. For although they are dimensionally correct they are not quite as correctly drawn as they might be. For example, the angle along the top of the front plate must be made in three sections, to clear the frames themselves. As drawn, the vertical angles on the rear buffer plate foul the brake weighshaft so they must be much shorter and the derailing guides previously held by these must now be inside the frames and a couple of inches forward. The pillars locating the brake cylinder housing make the ideal mounting points. Also, since the bolts concerned are a mere ⅜in. diameter, strength should be adequate! Again, more details later.

If you are planning to use standard ¼in. nuts for assembling brake gear, valve gear, etc. then the shouldered parts that I showed on such parts are adequate; but they will need locking in some way. However, a much nicer-looking way is to use stainless self-locking nuts (Nyloc, for example). In this case, make the shouldered-down parts ⅜in. long instead of whatever was shown.

Tip: after shouldering down to ¼in., screw-cut the thread. It will pay handsomely, for the force needed to cut the thread by plain die will certainly cause the pin to slip in the chuck. You might get away with mild steel parts. But silver steel or stainless iron - not in a month of Fridays. This brings to the fore the advantages of a quick-change gearbox; without it it is such a pain in the *gluteus maximus* to keep on

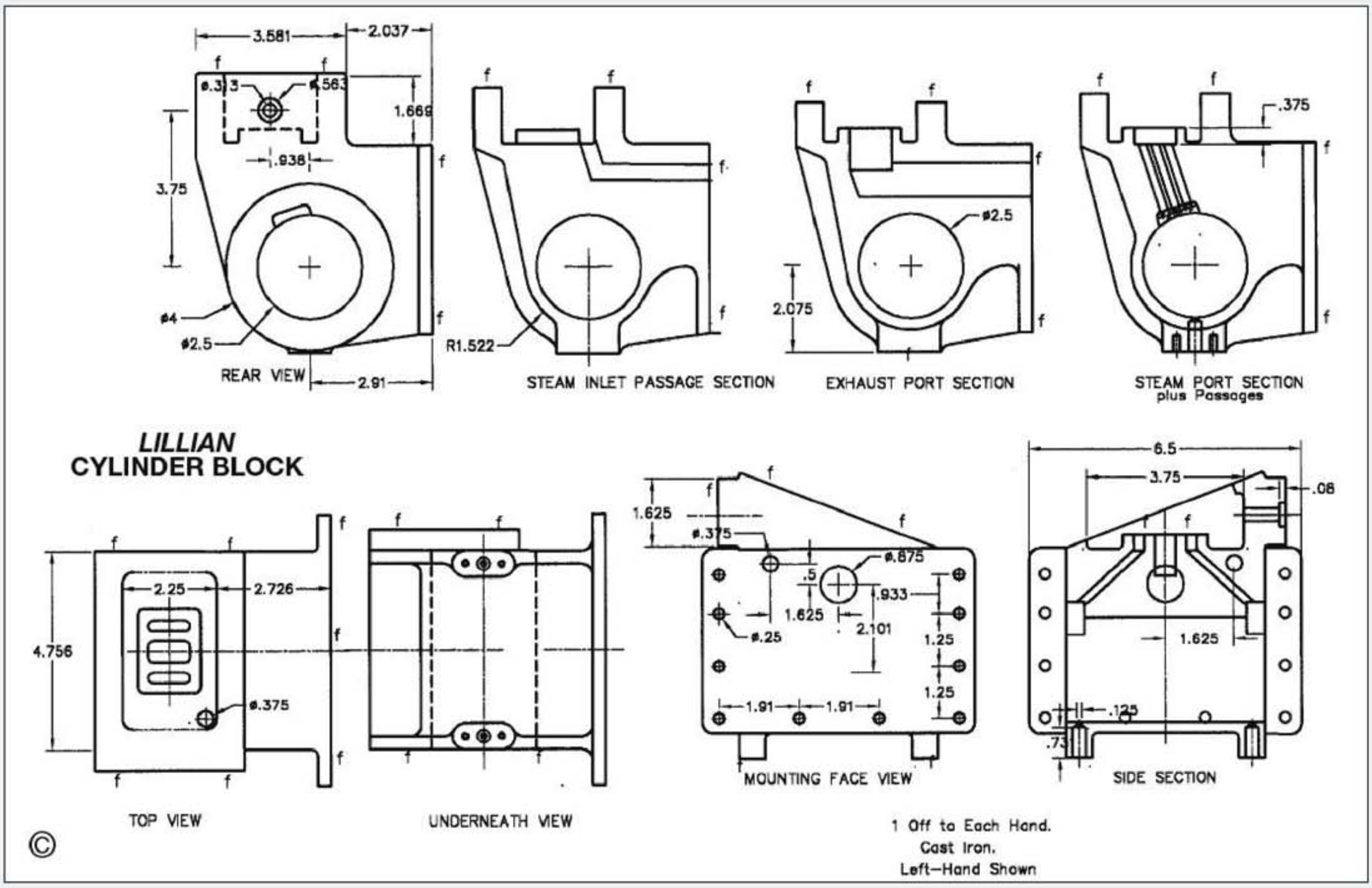


LILLIAN
CYLINDER SIDE VIEW



LILLIAN
CYLINDER PLAN VIEW

Wilson's Words of Wisdom:
The evidential value of any fact is an unknown quantity until that fact has been examined.



setting up gear trains. The result is that it is generally easier to forget screw-cutting, result - loss of accuracy. A bad workman blames his tools, and good work can be done on poor machinery, but 'tis vastly easier to do good work with good tools.

Another tip. If you can afford it, digital read-outs on milling machines soon pay for themselves and the speed – control devices for lathes etc. are a sound investment.

There is also the location of a couple of ring bolts on each buffer plate. These do not look too unsightly, and are a requirement of regulations in case of breakaway. With an automatic brake system this should not be needed. They are also darned useful in handling the engine, both under construction and in normal operation. The all-up weight of this lump of tractive effort looks like being about 750 pounds. If the square hole for the coupling in each buffer-plate is fitted with a square spacer drilled to suit the ring-bolt, then during construction one at each end will be most useful, for with a puffer this size even the mere frames are a bit weighty! An overhead crane or hoist is very strongly advised, and with a load-spreading beam and a selection of chains and shackles life will be a bit easier!

To my surprise, when I ordered these ring bolts from the local tool and hardware shop, I was told that they were known as dynamo bolts! The size is 10mm and they are about $1^7/8$in. O/D, 1in. I/D, with a 10mm stem.

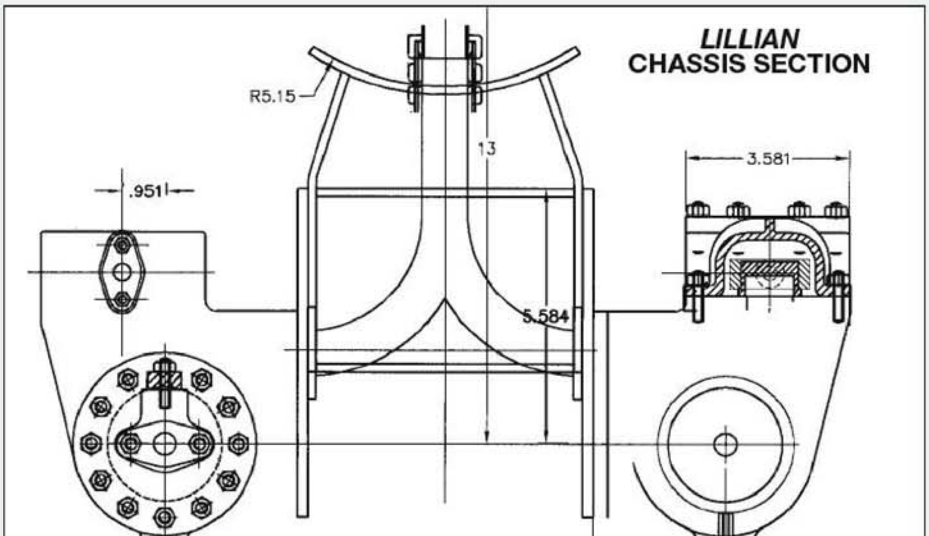
I have a bit of news on the hornblocks. In these days of high costs, it has been necessary to make the pattern for a single block rather than a double as shewn on my original drawings. This will make them a bit cheaper and a weeny bit more care will be needed when machining them. As long as they turn out as matched pairs, okay.

A similar argument applies to the cylinders. Originally as two 'handed' patterns, this would double the cost of pattern making and therefore upping the cost of the castings. You can choose for yourself whether you machine off the top of each to 'hand' the cylinders or leave them flat and use a flat top instead of the cast 'sloping' one as designed. I can't see it affecting the steaming of the engine in any way.

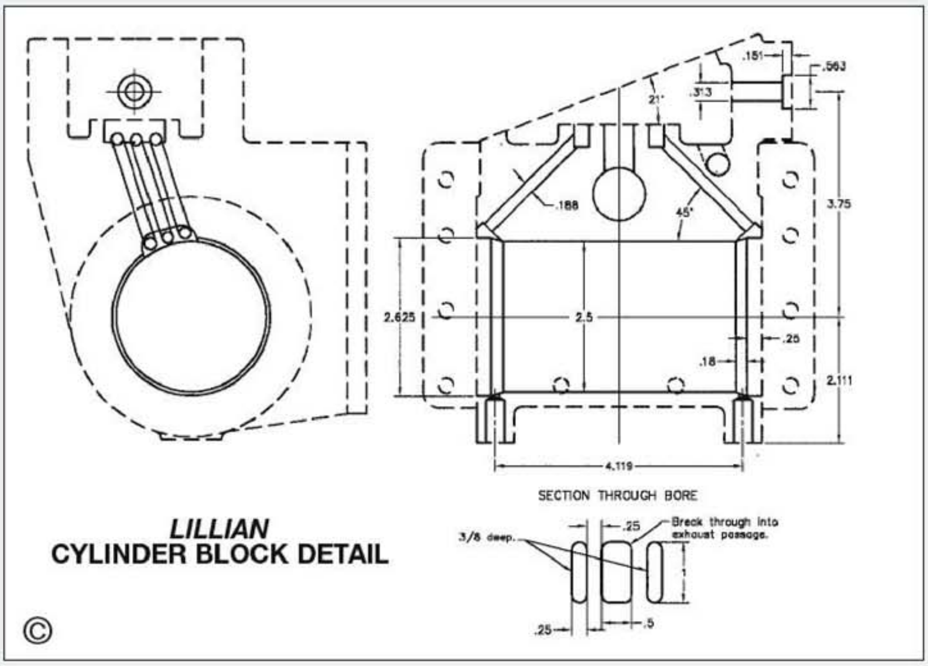
Cylinders

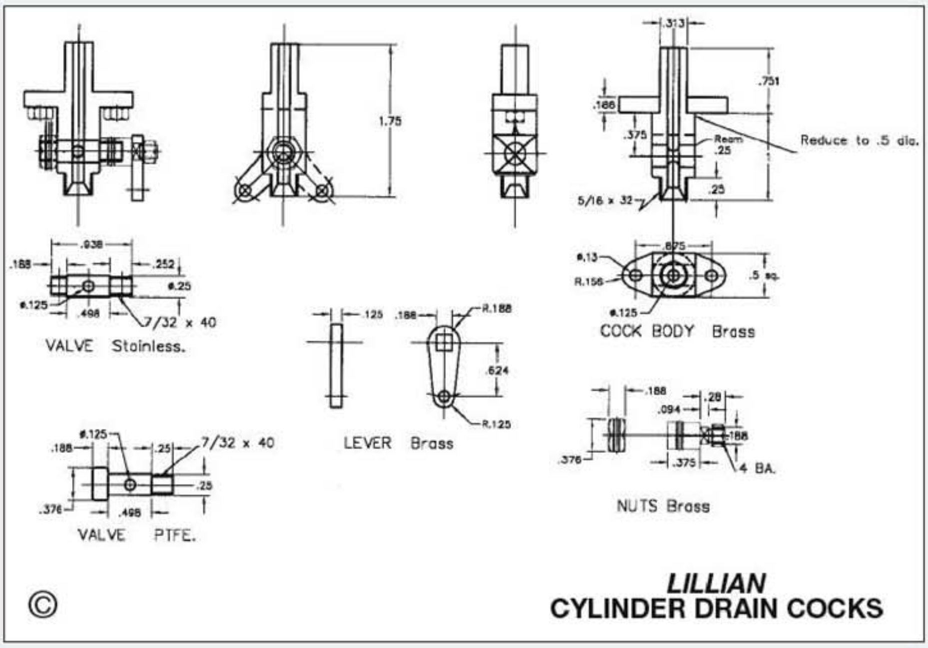
These drawings were originally done on one A1 sheet in the computer, but to reproduce such a sheet to about A5 (by the time it is published) size would make rather a small drawing. Therefore, I have done them out on A3 size; it makes them a bit easier to follow. After all, although the boiler is more costly than cylinders, a boiler has to be pretty bad before it ceases to be salvageable, whereas a mistake in the cylinders is usually hard to rectify.

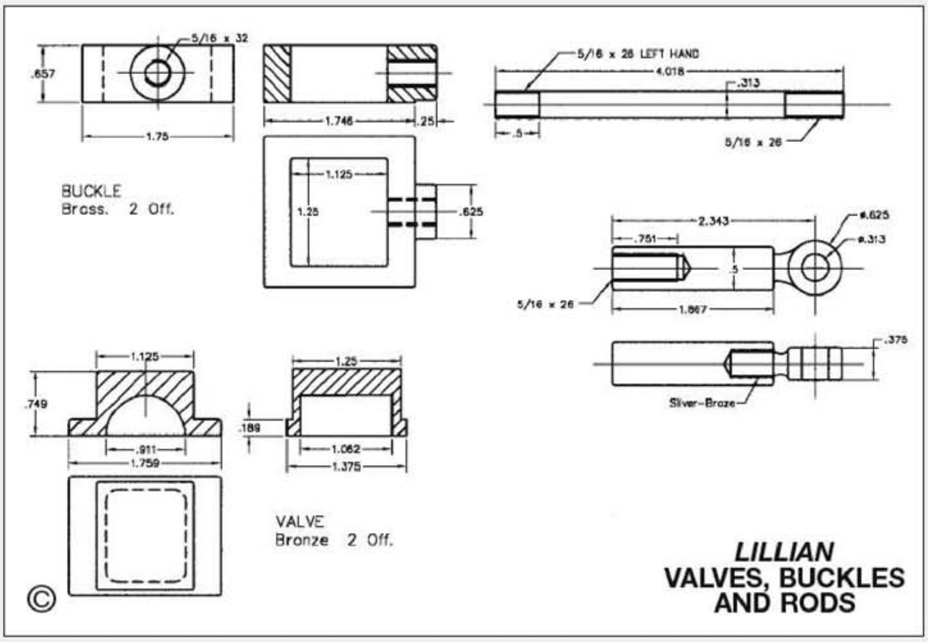
To my regret (and possibly yours too) these cylinders are too large to be machined on a $3^1/2$in. lathe; they are possibly the only bits that can't. They require just over 5in. swing to clear the lathe bed, and unfortunately they are also too big to be



***The substantial, laser cut frames and buffer beams for* Lillian.**







bored out by mounting on the cross-slide.

So for those with 5in. lathes or larger, the cylinder block may be clamped to the faceplate for the important task of boring the bore, but first one face must be machined true as a mounting face. The best one to choose is the face that mounts on the frames.

This can be done by gripping the block in a machine vice under a vertical milling head and 'cleaning up' with your largest end mill. Once this has been done (perfect finish not required) then the front face of the cylinder should be cleaned up. The nearer you can get this face at right angles to the bore and the mounting face the better, but 'tis not absolutely vital.

The bore itself is best done with the front face clamped (via some parallel packing blocks at least 7/8in. thick) to the lathe faceplate. Whereas it is possible to use a between-centres boring bar to bore out the bore, it makes life easier to do it with the cylinder block rotating. The reason is quite simple; with the block fixed and the tool rotating the cutting forces are oscillating up, across, down, across the other way and so on. With the block rotating, the cutting force is directionally constant. Not that good cylinders may not be done this way by between-centres boring, but I believe the block rotating is the best way. However, note a recent (*M.E.* 4229, 3 September 2004) article in the *Letters to a Grandson* series on this matter.

Open out to 2.49in. diameter if possible (an 'inside mike' is a good investment) and then use a hone to get spot-on to 2.5 inch. I mention in passing that honing can give a finish accurate to within some 0.00005in. or better, somewhat better than reaming. Incidentally, a floating adjustable reamer of appropriate size is a great asset in getting the initial bore to 2.49 inch. It is most useful if the front of the bore can be opened out to about 2.625in. diameter; it helps when assembling pistons complete with rings. There is no need to open out the rear end, but it helps to have it a bit larger if reboring is ever required. But, at the rear end, any bore enlargement *must* be concentric, so do it at the same setting. It only needs to be about 1/4in. deep.

As an example of the accuracy of honing, when I machined up 16 cylinders in a batch, the pistons

A Bulldog, part of a batch just completed by the author and looking resplendent on the track.

A magnificent 5in. gauge Ariel photographed on a track situated in the Isle of Man.

were completely interchangeable and even on holding up to the light, nothing could be seen in the way of clearances.

At the same setting as boring, clean up the rear face of the block. This will make it dead true to the bore, very important.

Based on the mounting face, milling to size of other portions of the block is straightforward. The port face is of particular importance as it must be dead flat. Most end mills on cast iron leave a pattern, probably best described as 'whorled'. It is not easy to get at, but cleaning up to a good dead-flat finish is essential, otherwise you will get steam blowing straight through to exhaust instead of doing useful work in the cylinders. It is probably best to leave the port face as milled until you have chewed out the ports, use a slot-drill for this, not an end-mill.

Another job needing careful milling operations is the rebate at each end of the cylinders; this must be deep enough to allow steam to emerge from the passages and dodge the location shoulder on the covers. Although, forsooth, a rebate in the cover corresponding can help it will not do quite as well. It helps passage-drilling muchly to have a flat surface at right angles (or very nearly so) to the passages. If you cannot manage an exact right-angle, then start each passage with a good centre-pop and open this out for about 1/8in. depth, 1/8in. diameter. This will help no-end with getting the passages right.

Drilling the steam passages is a bit troublesome, for if they break through into the wrong place you've got problems. I have tried to leave as much clearance as possible.

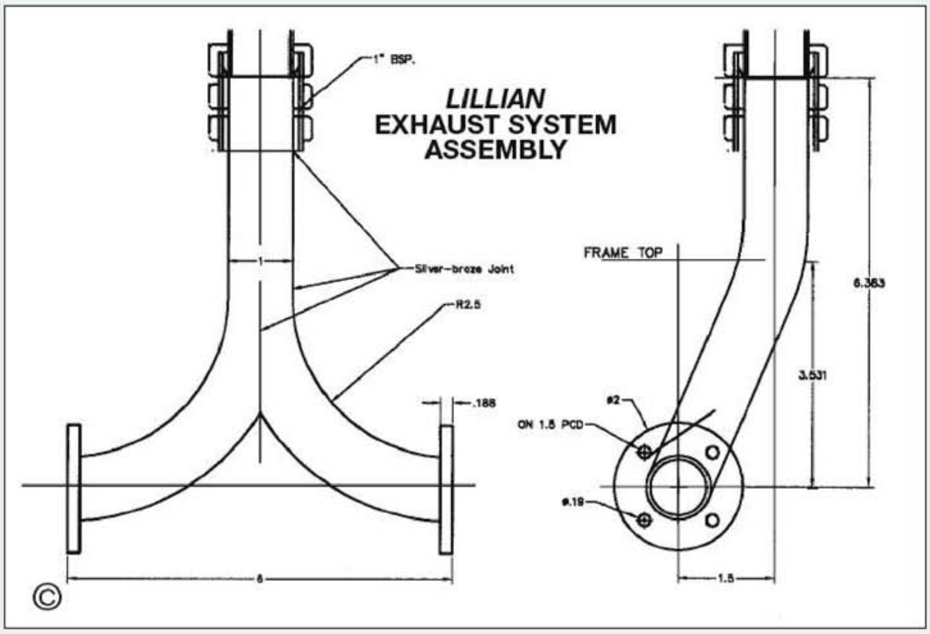
A good way of holding the block at the required angle for some jobs is to clamp it, by means of a couple of long studs, between a pair of angle plates. This can take care of some of the angular difficulties in drilling the passages. An adjustable angle plate (fairly substantial in size) is the best bet, as 'compound angles' can be set. Aim very carefully, and if possible use a smaller drill as a pilot.

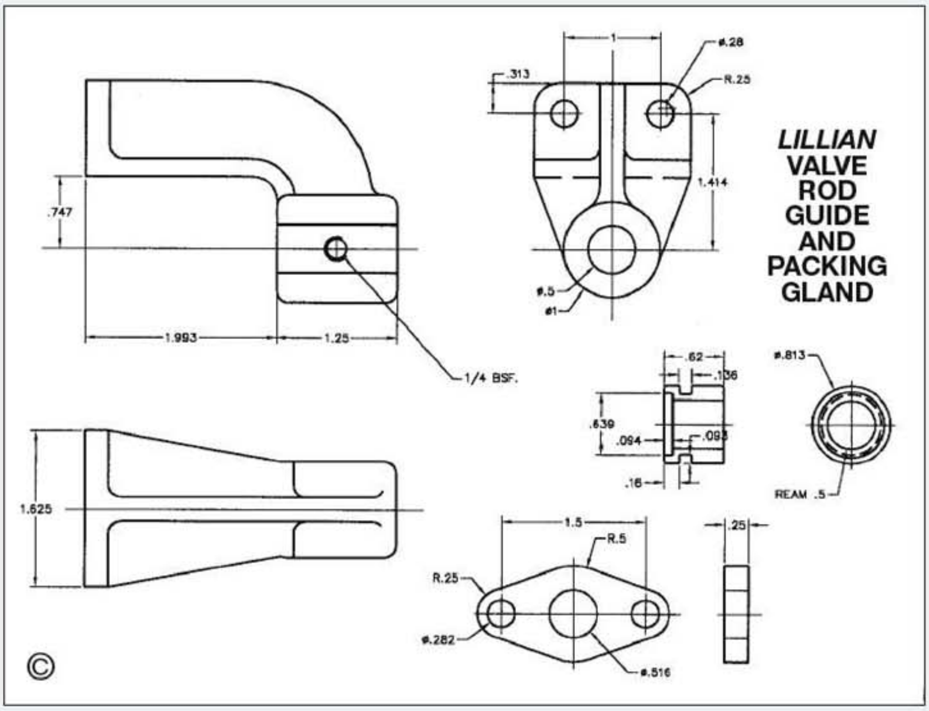
In drilling deep holes, particularly in cast iron, it pays to frequently withdraw the drill to clear chips; drills then tend to last longer, particularly small ones.

Once the main bore, ports and passages are done, do the two holes for the drain cocks, and don't forget the reamed hole near the top for the valve rods. The counter bore for an O-ring should be accurate, probably best done with a counter bore (pin drill) even if you have to purchase or make one.

It is a matter of choice where you locate the ten mounting holes from, either spotting through all ten from the frames, of spotting eight through the cylinder and leaving the hidden two to slightly less accurate methods. It might well need these two holes to be opened out somewhat, not much use if you cannot get a bolt through. It is best if all ten holes are reamed fits throughout, the bolts will then have the effect of dowel pins, locating more accurately and more tightly.

●*To be continued.*





CLUB CHAT

With Malcolm Stride

The first thing I would like to do in this issue is to announce some new developments for the club scene in *Model Engineer*. The first of these is to offer all you clubs out there the opportunity to submit a brief profile of your club for publication in this magazine. A length of around 700-800 words with a couple of photos ought to suffice and should include brief details of your club's main activities and contact details. Ideally, photos should be in digital form (3 megapixel+) but ordinary prints will be accepted. Please include full titles for the photos and acknowledgement of the photographer if required. The idea of this initiative is to enable clubs to publicise their activities and, perhaps, encourage more of you to get involved. 'Club Profiles' will be published on a first come first served basis so let us have your submissions.

The other thing I want to do is to try to gather together a collection of all those useful model engineering tips that are generated in the club environment. These can be on any model engineering subject you desire so, if you have an idea that has saved you time, effort or money in your activities, or is just a different way of doing things, then let us know. Again any photos would be useful.

Contributions for both of the above should be addressed to me at the Orpington editorial address which can be found on the contents page.

UK News

Bedford MES have been working on the redecoration of their club house and are installing a new heater so that "*meetings can be conducted in some degree of comfort*." The club are also preparing to host the LBSC Memorial Bowl event later in the year with some improvements to the elevated track.

Cambridge MES invites members of model engineering societies to their two day rally to be held on 25/26 June 2005. The ground level track provides $3^1/2$, 5 and $7^1/4$in. gauges using aluminium alloy rail. It runs through interesting woodland scenery with drivers likely to encounter pheasants and squirrels along the track. There is also an extensive 16mm layout. All models are welcome, whether locomotives, traction engines, or stationary engines, together with their owners, drivers, driver's mates, and families. For anyone whose interest in model engineering is quickly satisfied the City of Cambridge is an alternative attraction within walking distance. Where else, for instance, will you find a statue of Henry VIII holding a wooden chair leg? Limited camping and caravan places are available and visitors are advised to book well in advance. Boiler test certificates are required and, because of the multi-gauge points the society may need to check locomotive and driving truck wheel gauges. For further details, and to book camping/caravan spaces contact Andrew Clarke on 01223-880639. A suggestion has been made to the society that the provision of bat nesting boxes around the site may provide protection against development by preventing developers getting rid of the bats (and the society). Ian Morris recounts the tale of the first passenger runs with the new vacuum brakes in use. When the train stopped, the electric pump (which was mounted under the carriage seat) cut in and an ecstatic smile spread across the face of the lady sitting above said pump!

Elmdon MES report a busy year last year with activities including open days for the Wythall Bus Museum, and the portable track in action at the Belbroughton Scarecrow weekend among others. Plastic sleepers have been purchased and were being fitted over the winter. Some water and sewer problems have also been attended to. The repair of the water leak involved lifting a section of the track. An interesting project has been the use of a load cell to measure the drawbar pull of different engines pulling the club coaches.

Harlington Locomotive Society have sent details of their visiting clubs day this year which is to be held on 18 June. The event is open to members of other clubs (but not the public) and further details can be obtained from the secretary at Harlington Locomotive Society, High Street, Harlington, Middlesex UB3 5DF or from the website at www.hls.uk6.net Peter Tarrant reports that over the last 12 months the society has had "*a very busy steaming year*" with regular children's parties and events for several local charities. The gauge '1' railway is growing swiftly with even more track and points and has enjoyed regular steam ups on non - public days. The society has received a grant from British Airports Authority at Heathrow which will enable the builders to start work on a club house annex. By the time you read this, the sack full of daffodils donated by Ground Work Thames valley will be in bloom around the site and hopefully adding a splash of colour.

The **Leyland SME** suffered a slight setback to its normal high level of operational availability, when, not leaves, but a large chunk of a 300 year-old chestnut tree fell on its line in the gales early in January. The local Parks Department was enjoying its Christmas break at the time but soon returned to the fray, chainsaws at the ready to remove the offending debris from the line immediately on the cessation of festivities. The

CLUB DIARY

A minimum of 6 weeks notice is required for diary entries. Clubs and Societies are asked to include a telephone number for the assistance of would-be visitors.

MAY

14/15	**Chesterfield MES.** *Open Weekend.* Contact Mike Rhodes: 01623-648676.
14/15	**Guild of Model Wheelwrights.** *Tolkien Weekend, Sarehole Mill, Moseley, Birmingham.* Contact Biddy Hepper: 01492-623274.
14	**Northampton SME.** *Birthday Party – Diane Latchford.* Contact Pete Jarman: 01234-708501 (eve).
15	**Bedford MES.** *Public Running.* Contact Ted Jolliffe: 01234-327791.
15	**Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.
15	**Edinburgh SME.** *Open Day.* Contact Robert McLucke: 01506-655270.
15	**Frimley & Ascot LC.** *Club Running.* Contact Bob Dowman: 01252-835042.
15	**N. W. Leicester SME.** *Public Running.* Contact John Elliott: 01455-847040.
15	**Oxford (City of) SME.** *Public Running.* Contact Chris Kelland: 01235-770836.
15	**Plymouth MSLS.** *Public Running.* Contact John Brooker: 01752-671722.
15	**Saffron Walden DSME.** *Running Day (public running after 2pm)* Contact Jack Setterfield: 01843-596822.
15	**St. Albans DMES.** *Club Running.* Contact Roy Verden: 01923-220590.
15	**Taunton ME.** *Public Running.* Contact Don Martin: 01460-63162.
15	**Wimborne DSME.** *Public Running.* Contact Eric Basire: 01202-897158.
15	**York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.
16	**Model Steam Road Vehicle Soc.** *Modellers' Evening.* Contact Geoff Miles: 01869-247602.
16	**Peterborough SME.** *Welding Techniques.* Contact Tony Meek: 01778-345142.
17	**Chesterfield MES.** *Railway Films.* Contact Mike Rhodes: 01623-648676.
17	**Erewash Valley MES.** *Fireworks Talk.* Contact Jim Matthews: 01332-705259.
17	**North Cornwall MES.** *Club Meeting & Track Evening.* Contact Ray Reed: 01237-424254.
17	**Nottingham SMEE.** *Doug Hewson: Building 5in. gauge wagons.* Contact Graham Davenport: 0115-8496703.
17	**South Durham SME.** *Afternoon Steam-Up.* Contact B. Owens: 01325-721503.
17	**Taunton ME.** *Car restoration, chats on Austin, Riley & MG.* Contact Don Martin: 01460-63162.
18	**Bournemouth DSME.** *Paul Carter: How to stick things together.* Contact Dave Fynn: 01202-474599.
18	**Guildford MES.** *Last Bits & Pieces.* Contact Dave Longhurst: 01428-605424.
18	**Leeds SMEE.** *Meeting Night.* Contact Colin Abrey: 01132-649630.
19	**Grimsby Instituite Model Makers & Metal Users Group.** *Open Night.* Contact Derek Stanbridge: 01472-311222 (ext. 296).
19	**Isle of Wight MES.** *Barbecue Night.* Contact Ken Stratton: 01983-531384.
19	**Sutton MEC.** *More Cutter Grinding.* Contact Bob Wood: 0208-641-6258.
20	**Brighton & Hove SMLE.** *Running Evening.* Contact Mick Funnell: 01323-892042.
20	**Canvey R&MEC.** *On the Table 2.* Contact Brian Baker: 01702-512752.
20	**MELSA.** *Monthly Club Meeting.* Contact Graham Chadbone: 07-4121-4341.
20	**North London SME.** *Work in Progress.* Contact David Harris: 01707-326518.
20	**Rochdale SMEE.** *Roger Thornber: Model Making in Gauge 1.* Contact Mike Foster: 01706-360849.
21	**Chesterfield MES.** *Running Day.* Contact Mike Rhodes: 01623-648676.

local authority has suggested that the society should keep well clear of the tree in question until they have reviewed the safety issues involved, and the future of this beautiful tree now hangs in the balance while the club awaits the outcome of the council's deliberations. Fortunately they are still able to run on the ground level track and so can maintain a limited service to the public.

The Chairman of **Portsmouth MES** reports that the club efficiency competition was attended by six locomotives. He puts the low turnout down to a clash with Portsmouth Football Club's first match of the season. Let's hope Pompey won! The winners were John Russan with his *Maisie* in $3^1/2$in. gauge and Phil Carey with his 5in. gauge 'Simplex'. Both drivers are reported as having relaxed steady drives. Ted Gowing describes the 1906 Dewar Trophy car race at Daytona Beach in 1906 when the event was won by a steam car. This was a special Stanley steamer using the same basic engine as their road cars but with an oversize gasoline fired vertical boiler with 700 half inch fire tubes working at about 500psi. Driver Fred Marriott took the flying mile at a new land speed record of 127.66mph and the next day took the flying kilometre record at 121.57mph.

Saffron Walden & DSME took delivery of a new container in late December and had the problem of moving it across the picnic field. The solution devised was to put a wheel at each corner and tow it across the picnic field on some portable rails (8ft. gauge – even bigger than Brunel's efforts!) using a mini digger.

We are delighted to report that Ivan Smith, Chairman of the **Stockholes Farm Miniature Railway Society** has been awarded the Southern Federation Annual Award for 2004. The presentation was made at the Harrogate exhibition. The society 'Broken Spoke Award' was awarded to two of the society junior members, Thomas Chatham and Joshua Hague for their contribution to the railway. It is nice to see juniors being recognised for their contributions in these days of vandalism and other mindless activities. May we congratulate Ivan, Thomas and Joshua on their awards.

Members of **Wigan & DMES** had a first-class talk by Brian Woodward on the rebuilding of the Welsh Highland Railway from Waun Fawr to the current terminus at Rhyd-Ddu. Among the interesting techniques described was the use of a thermometer when track laying. This is used to ensure that the correct gap is left between rail ends by means of distance pieces used for different temperatures. Those clubs with expansion problems in hot summers may like to think about this approach!

Worthing & DSME report that they now have an electric locomotive and a 'Netta' available for running duties and are looking for volunteers to man them. By the time you are reading this the new boiler for the 'Speedy' will have been delivered and work should be in progress with the installation.

World News

Canada

Bruce Wilson was honoured as 'Man of the Year' by members of the **British Columbia SME** recently for his outstanding service and efforts on behalf of the club in 2004. We also send our warmest congratulations to Bruce. Doug Bach writes about his experience in *"taming injectors"*. This related to two injectors designed for an upper pressure limit of 100psi which he wished to use on the club 'Northern' locomotive. Some of you may be aware that in order to raise the pressure limit it is necessary to allow more water into the injector cone. This can be done by adding a shim between the injector body and the steam cone thus increasing the gap (annulus) between the steam and combining cones. Doug found that a 0.005in. shim increased the upper limit by approximately 15psi and a 0.01in. shim took it above the 125psi safety valve setting on the locomotive. That is exactly the sort of 'tip' I am looking for the new addition to the club scene.

At the march meeting of the **Toronto SME** several interesting projects were described including Ron Melvin's making of a back plate for his new 4-jaw chuck. Accuracy being most important the first task was to create a thread gauge replicating the Class 2 thread of the lathe spindle nose. Ron explained the use of thread wires and the data from Machinery's Handbook in making this. Handling the thread wires while taking micrometer readings was described as tricky and needing an extra pair of hands and was resolved by embedding the wires in a wine cork. Gary Rose described and demonstrated a controller he has built to give more power to a small CNC machine. It consists of a 3 axis controller board run by a computer to drive stepper motors from a 24v power supply. It has upped the table speed from 4in./min maximum to a maximum of almost 60in./min although the use of such speeds is not practical. The ▶

In Memoriam

It is with the deepest regret that we record the passing of the following members of model engineering societies. The sympathy of staff at *Model Engineer* is extended to the family and friends they leave behind.

Colin Alistair Bowden	*British Columbia SME*
John Dunne	*Havelock North Live Steamers (NZ)*
Ron Scott	*Elmdon MES*

21 **Guernsey Model Engineering Society.** *Boiler Testing.* Contact Dave Simon: 01481-251017.
21/22 **Guild of Model Wheelwrights.** *Boscobel House, Nr. Telford.* Contact Biddy Hepper: 01492-623274.
21 **Romford MEC.** *St. Francis Hospice Track Run.* Contact Colin Hunt: 01708-709302.
21/22 **Surrey SME.** *The Fourth Southern Railway Rally.* Contact John Cook: 020-8397-3932.
21 **Steam LS of Victoria.** *Club Run.* Contact Graham Plaskett: (03) 9750-5022.
21/22 **Tyneside SMEE.** *TSMEE Spring Rally.* Contact Ian Spencer, 0191-2843438.
21 **York City & DSME.** *Best Work of the Year.* Contact Pat Martindale: 01262-676291.
22 **Bedford MES.** *ModelWorks Owners' Rally.* Contact Ted Jolliffe: 01234-327791.
22 **Edinburgh SME.** *Running Day.* Contact Robert McLucke: 01506-655270.
22 **Guildford MES.** *Public Running.* Contact Dave Longhurst: 01428-605424.
22 **Harlington LS.** *Charity Open Day.* Contact Peter Tarrant: 01895-851168.
22 **Leicester SME.** *Teddy Bear's Picnic.* Contact Raymond Wallis: 0116-285-8824.
22 **Wigan DMES.** *Annual Dinner.* Contact John Chamberlain: 01744-882255.
25 **Hull DSME.** *Table Sale.* Contact Tony Finn: 01482-898434.
26 **Brighton & Hove SMLE.** *Workshop Evening.* Contact Mick Funnell: 01323-892042.
26 **Leyland SME.** *Vic Whittaker: Printing Presses.* Contact A. P. Bibby: 01254-812049.
26 **Sutton MEC.** *New Drivers Run.* Contact Bob Wood: 0208-641-6258.
26 **Worthing DSME.** *Bits & Pieces.* Contact Bob Phillips: 01903-243018.
28-30 **Bedford MES.** *AGM, Exhibition & Miniature Traction Engine Rally.* Contact Ted Jolliffe: 01234-327791.
28 **Brighton & Hove SMLE.** *Trackday.* Contact Mick Funnell: 01323-892042.
29 **Amnerfield Miniature Railway.** *Public Running.* Contact David Jerome: 0118-9700274.
29/30 **Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.
29/30 **Cardiff MES.** *Open Days.* Contact Trevor Jenkins: 029-2075-5568.
29/30 **Claymills Pumping Engines.** *Open Days.* Contact B. Eastough: 01283-812501.
29 **Edinburgh SME.** *Open Day.* Contact Robert McLucke: 01506-655270.
29/30 **Elmdon MES.** *Two Museum Days.* Contact Chris Giles: 0121-458-1291.
29/30 **Malden DSME.** *Public Running.* Contact John Mottram: 01483-473786.
29 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
29 **North Cornwall MES.** *Steam-Up.* Contact Ray Reed: 01237-424254.
29/30 **Oxford (City of) SME.** *Public Running.* Contact Chris Kelland: 01235-770836.
29 **Steam LS of Victoria.** *Working Bee & Barbecue lunch.* Contact Graham Plaskett: (03) 9750-5022.
29 **Reading SME.** *Public Running.* Contact Brian Joslyn: 01491-873393.
30 **Brighton & Hove SMLE.** *Carnival Trackday.* Contact Mick Funnell: 01323-892042.
30 **New Jersey Live Steamers, Inc.** *Memorial Day Run.* Contact Karl Pickles: 718-494-7263.
30 **Northampton SME.** *IMLEC Rehearsal with Dynamometer Cars.* Contact Pete Jarman: 01234-708501 (eve).
30/31 **Northern Mill Engine Society.** *Open Days.* Contact John Phillp: 01257-265003.
30 **Saffron Walden DSME.** *Running Day with Barbecue (public running after 2pm).* Contact Jack Setterfield: 01843-596822.
30 **Stockholes Farm MR.** *Spring Bank Holiday Running.* Contact Ivan Smith: 01427-872723.
30 **Taunton ME.** *Public Running.* Contact Don Martin: 01460-63162.

JUNE
1 **Bradford MES.** *Stan Reffin: Miniature R/C Boats.* Contact John Mills: 01943-467844.
1-4 **East Somerset SMEE.** *RB&W Show plus grand opening of railway to public.* Contact Roger Davis: 01749-677195.
1-4 **Guild of Model Wheelwrights.** *Royal Bath and West Show, Nr. Shepton Mallet.* Contact Biddy Hepper: 01492-623274.
2 **Norwich DSME.** *An Evening with Norfolk Railway Society.* Contact Paul Reed: 01603-462925.
2 **South Lakeland MES.** *Meeting.* Contact Adrian Dixon: 01229-869915.
2 **Sutton MEC.** *Bits & Pieces.* Contact Bob Wood: 0208-641-6258.
3 **Aylesbury (Vale of) MES.** *Track Night.* Contact Andy Rapley: 01296-420750. ▶

software used is TURBOCNC, which incidentally we are told is free. (It is actually shareware and can be found at website: **http://www.dakeng.com/turbo.html** which in addition to some other interesting looking software also has a gallery of work produced using the TURBOCNC). The meeting closed with a brief description by Peter Trounce of a Sherline mill with computer driven CNC programmed for machining expansion links. The system is complete except for a monitor for less than US$3000. With all this electrical work the Editor comments "*Too many sparks and not enough swarf!*"

New Zealand

At the November 'Bits & Pieces' evening of **Auckland SME** the first item was a weight driven pendulum clock, made by the Lea Recorder Co., Manchester, England about 1950 and was used in a ship's engine room. The owner, Bob Craig said it was used to measure stroke rates of pumps by comparison to pendulum beats. Terry Boyd had a very nicely made four way front tool post and a rear tool that he had produced for a Myford Lathe, in toolmakers finish. An example of crankshaft making was shown by John Olsen, being a three-throw crankshaft some 8 to 10in. long. The main metal between the webs had been removed by milling, John considering this to be less *"risky"* than wholly turning. Turning between centres was of course used to finish to size. Wedges were 'Loctited' between the webs for support; these are easily removed on completion of the turning. Alan Gasteen showed the front 4-wheeled bogie for his Class 4 British Railways Tank locomotive. This will be a very high-class model indeed. Murray Lane is *"into"* model aircraft construction and had on the table a scale model of a Cessna Skymaster undercarriage with retracting wheels. The next item was the handbrake lever for Graeme Bell's Marshall road roller. This is a rotational device, which operates through a square thread and a nut to put on the brake. Graeme screw cut the screw on the lathe making it longer than needed. He then cut off a portion and used this as a tap to produce the nut, giving a very good result. Warren Green showed some of the parts of the Stuart Turner *Sirius* engine that he is working on at the moment. Derek Simons brought along an electric motor with a torque unit attached, which can give full speed control from full down to quarter the speed of the motor. This variation is achieved by an eccentric cam system and is used for driving a film projector. The last item was a small Perspex box made by gluing the sides onto a base. It was the clever application of the adhesive, in such a way that it went only where it was required, that made the article interesting (another tip perhaps?). Graeme Murray was the constructor.

South Africa

The newsletter of the **Rand SME** carries a note on driving a model of the SAR GB Garratt 2-6-2+2-6-2 locomotive. It is stated that they are lethal because the driver sits on the rear engine unit and is subjected to a constant stream of sulphurous smoke and oil and if pulling a good load and the engine units become synchronised, huge quantities of hot coals and ash are drawn off the fire and fired into the driver's face resulting in a "*week of coughing to clear the lungs*". They also point out that cleaning a Garratt is tiresome but cleaning oneself after a long day on the track leaves a perfect black ring round the bath. I can confirm that much the same effect occurs when driving an 0-4-0 Railmotor on a ground level track because the locomotive is so short you end up looking almost straight down the chimney. I can also confirm that a shower will spread the muck over a much larger area of the bath! Steady progress is being made with the construction of the first club 7¹/4in. gauge Lawley locomotive. The locomotive is to have a steel boiler which is being designed based on the Australian model boiler code practice. The Tangye stationary engine in the museum has been connected to an alternator and now acts as 'local generator'. A big end knock on the engine was solved with "*expert scraping of the bearing*".

3	**Brighton & Hove SMLE.** *Working Evening.* Contact Mick Funnell: 01323-892042.
3	**Canvey R&MEC.** *Steam-Up with Food.* Contact Brian Baker: 01702-512752.
3	**Maidstone MES (UK).** *Evening Run.* Contact Martin Parham: 01622-630298.
3-5	**New Jersey Live Steamers, Inc.** *Spring Meet.* Contact Karl Pickles: 718-494-7263.
3	**North London SME.** *Derek Brown: Anna.* Contact David Harris: 01707-326518.
3	**North Norfolk MEC.** *Traction Engines & Static Engines.* Contact Gordon Ford: 01263-512350.
3	**Rochdale SMEE.** *Quiz Night.* Contact Mike Foster: 01706-360849.
3	**Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.
4	**Amnerfield Miniature Railway.** *Diesel & Electric Visitors Day.* Contact David Jerome: 0118-9700274.
4/5	**Aylesbury (Vale of) MES.** *Annual Miniature Traction Engine Rally.* Contact Andy Rapley: 01296-420750.
4	**Guernsey Model Engineering Society.** *Casting.* Contact Dave Simon: 01481-251017.
4	**Ickenham DSME.** *Public Running.* Contact David Sexton: 01895-630125.
4/5	**Kew Bridge Steam Museum.** *Kew Bridge Model Boat Show.* Information: 020-8568-4757.
4/5	**Melton Mowbray DMES.** *Whissendine 2005.* Contact Phil Tansley: 0116-2673646.
4	**Romford MEC.** *Trackside Afternoon.* Contact Colin Hunt: 01708-709302.
4	**SM&EE.** *Competition Day and Working Model Display* Contact David Boote: 01202-745862.
4	**South Lakeland MES.** *Open Day.* Contact Adrian Dixon: 01229-869915.
4-5	**Wrexham DSME.** *Narrow Gauge IMLEC.* Contact Paul Malin: 01691-650429.
5	**Birmingham SME.** *BSME Summer Gala.* Contact John Walker: 01789-266065.
5	**Frimley & Ascot LC.** *Public Running.* Contact Bob Dowman: 01252-835042.
5	**Leyland SME.** *Charity Day.* Contact A. P. Bibby: 01254-812049.
5	**Malden DSME.** *Public Running.* Contact John Mottram: 01483-473786.
5	**Northampton SME.** *Public Running Day.* Contact Pete Jarman: 01234-708501 (eve).
5	**Oxford (City of) SME.** *Public Running.* Contact Chris Kelland: 01235-770836.
5	**Plymouth MSLS.** *Public Running.* Contact John Brooker: 01752-671722.
5	**Reading SME.** *Public Running.* Contact Brian Joslyn: 01491-873393.
5	**Rugby MES.** *Models Day.* Contact David Eadon: 01788-576956.
5	**South Durham SME.** *Running Day.* Contact B. Owens: 01325-721503.
5	**Steam LS of Victoria.** *Public Running.* Contact Graham Plaskett: (03) 9750-5022.
5	**Taunton ME.** *Public Running.* Contact Don Martin: 01460-63162.
5	**Wimborne DSME.** *Public Running.* Contact Eric Basire: 01202-897158.
6	**Peterborough SME.** *Bits & Pieces.* Contact Tony Meek: 01778-345142.
7	**North Cornwall MES.** *Club Meeting & Track Evening.* Contact Ray Reed: 01237-424254.
7	**South Durham SME.** *Running Day.* Contact B. Owens: 01325-721503.
7	**Taunton ME.** *Welding Evening.* Contact Don Martin: 01460-63162.
8	**Bradford MES.** *Meeting.* Contact John Mills: 01943-467844.
8	**Brighton & Hove SMLE.** *Wrinklies Running Day.* Contact Mick Funnell: 01323-892042.
8	**Cardiff MES.** *Kids Out Day with Cardiff East Rotary Club.* Contact Trevor Jenkins: 029-2075-5568.
8	**Hull DSME.** *Members' current projects.* Contact Tony Finn: 01482-898434.
8	**Leicester SME.** *Open Evening for local Railway Societies.* Contact Raymond Wallis: 0116-285-8824.
8	**St. Albans DMES.** *An Evening at Chipperfield.* Contact Roy Verden: 01923-220590.

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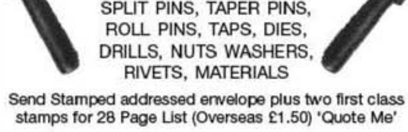

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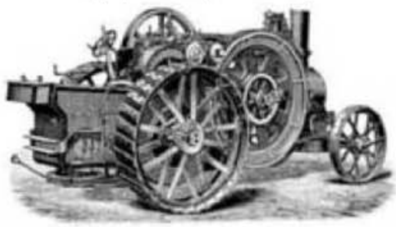

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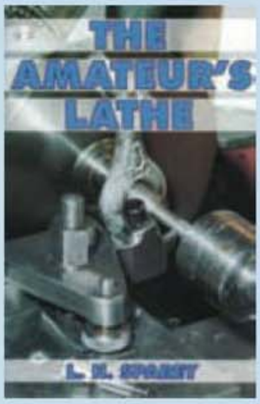

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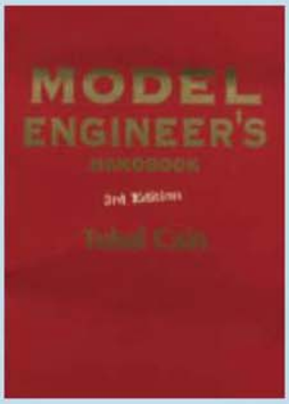

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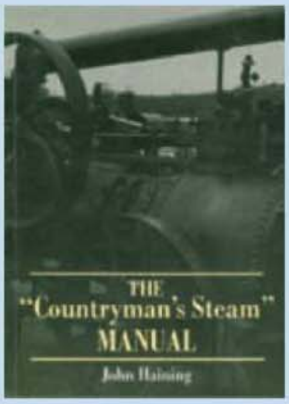

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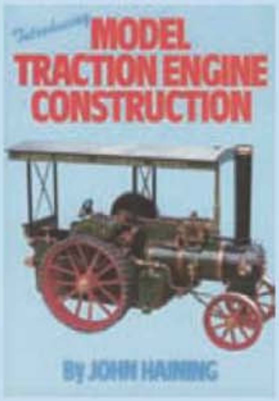

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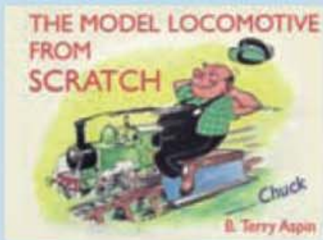

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